IV.—NOTES ON ENTOZOA OF MARINE FISHES OF NEW ENGLAND, WITH DESCRIPTIONS OF SEVERAL NEW SPECIES.

By Edwin Linton.

In the summers of 1884–'85 I collected Entozoa from several of the commoner species of food-fishes and Selachians at the summer station of the U. S. Fish Commission, Wood's Holl, Mass.

Cestoid entozoa in the adult or strobile condition were found in great numbers in the alimentary tracts of all the Selachians examined. Encysted forms of the *Cestoidea* are for the most part confined to the *Teleostei* and are found in greatest abundance in the submucous coat of the stomach and intestine, although not infrequently met with in the peritoneum, liver, spleen, ovaries, &c. In every specimen of such fishes, as the Bluefish (*Pomatomus saltatrix*), Squeteague (*Cynoscion regale*), Striped Bass (*Roccus lineatus*), &c., examined, the walls of the alimentary tract were spotted thickly with minute cysts, which, when opened, were found to contain larvæ of some Cestods, most of them of the genus *Rhynchobothrium*. Some from the submucous coat of the Squeteague (*C. regale*) seem to be larvæ of the species which I have named *R. bisuleatum*.

In the gall-bladder of nearly every specimen of Squeteague (*Cynoscion regale*) that I have examined, I found hundreds of larval *Tetrabothria*. They are usually attached to the walls of the cystic duct in clusters of such size as to obstruct the passage. (Plate VI, Figs. 6 and 7.) They are easily dislodged and often may be seen in vast numbers in the amber-colored contents of the gall-bladder. These larvæ, when placed in sea-water, are quite active. Each moves by alternately thrusting forward a pair of bothria and by alternate contraction and extension of the body. While this is in progress the body is constantly changing its form. At times it is long and filiform, at others short and broad. At rest it is commonly thickened or obtuse in front, tapering posteriorly. The body of the larva consists of a thin limiting membrane about 0.05^{mm} thick, inside of which is a granular parenchyma, the latter a clear fluid filled with highly refractile globular masses averaging 0.01^{mm} in diameter. The bothria are four in number, without hooks, and in the majority of those examined, without costæ. In some specimens there seems to be the beginning of an auxiliary acetabulum at the apex of each bothrium.

The apex of the head, at times obtuse or even retuse, is frequently elevated into a terminal papilla, disclosing a conical proboscis and terminal os like that of *Echeneibothrium*. The entire head is sometimes invaginated. The length is difficult to determine, on account of the extreme variability of form, but the average length when at rest is not far from 2.5mm. When placed in fresh water they are apt to assume a filiform shape, with a length of from 4 to 6mm. When disturbed they contract to 1.5mm or less. Many of these larvæ have two small red blotches immediately behind the bothria. A water vascular system can be distinguished in most of them. This consists of a convoluted tube on each margin, becoming evidently double near the head and forming a loop in front of the bothria and giving off branches to the bothria. Larvæ resembling those from the gall-bladder, but smaller, were also found in the intestine of the Squeteague (*Cynoscion regale*) and of the Angler (*Lophius piscatorius*). These, wherever noticed, were in myriads, floating free in the chyle. (Plate VI, Figs. 8 and 9.)

Elongated cysts were found in the liver, or peritoneum, of most of the *Teleostei* that were examined. These when opened set free an endocyst which is contractile and has the power of locomotion to some extent. When subjected to the action of the compressor, lateral vessels can be discerned which are evidently parts of a water vascular system. When one of these endocysts (*blastocysts* Diesing), that is sufficiently developed, is opened, it will be found that an embryo has been developed within. In some, this embryo seems to be free in the parenchyma, and when the wall of the blastocyst is ruptured, it is at once freed from its living envelope. The development in this case seems to be analogous to the development of *Cercariæ* in a Sporocyst.

In other cases the neck of the embryo is protruded from the side of the blastocyst in the form of a loop. When further pressure is applied the head is released, while the blastocyst remains attached to the scolex much like the bladder of a *Cystocercus*. The embryo, however, it will be observed, is not released by evagination, as in *Tænia*.

Nematods were found in most of the fish that were examined, both free in the alimentary canal and encapsuled in the peritoneum, gastric cæca, liver, &c. They were found in the greatest numbers in the peritoneum of the Angler (*Lophius piscatorius*), from a single specimen of which hundreds of the Nematoid, *Agamonema capsularia* Dies., were obtained.

Several Trematods were met with, most of them free in the stomach of their host, but not so abundant as either the *Cestoidea*, *Nematoidea*, or *Acanthocephala*. These will be described in a subsequent paper.

The only fishes that were found comparatively free from intestinal parasites were the Sea-Robins (*Prionotus*), while a Sturgeon (*Acipenser sturio*) yielded but one specimen, a Nematod from the alimentary canal, and a few Trematods from the gills.

In the descriptive part of this paper I have confined my attention to the *Cestoidea* and the *Acanthocephala*, and with two exceptions, viz, *Dibothrium aluterœ* and *Echinorhynchus sagittifer*, to adult forms.

In the determination of genera I have been guided principally by Diesing's Revisions. Accepting the characters there enumerated, I have been compelled to create three new generic names, viz: *Spongiobothrium*, *Crossobothrium*, and *Phorciobothrium*.

For the determination of species I have made use of the publications of Rudolphi, Diesing, P. J. Van Beneden, Dujardin, Von Linstow, Wagener, Krabbe, Olsson, Eschricht, Leuckart, Küchenmeister, Zürn, Von Siebold, Leidy, Cobbold, and others.

Systematic work on the Entozoa is attended with much difficulty on account of the confusion in which the earlier literature is involved. In this connection I take the liberty of quoting a brief passage from Von Linstow's "Compendium der Helminthologie," Hannover, 1878:

"The number of well-founded species is indeed not quite so great as the list indicates, for a host of older names, especially originating with Rudolphi, figure in it, of which typical examples are no longer in existence, and which have been described imperfectly or not at all, so that they must remain forever an unsolved riddle. For example, many rudiments of *Tœniæ* discovered by this author, whose enumeration has been of not the least advantage to science, and many descriptions of older date have not since been recognized. One comes from their contemplation often in great perplexity of mind, and does not really know how they ought to be represented. Moreover, to make the entire literature effective was impossible, since too many species are described in such a way that it is not possible to recognize them again, and other specifications are so improbable that for this reason they must remain unconsidered; * * * when further the description of a new species is disposed of with an enumeration of the length and breadth, when, finally, for new species only the place where they are found is given, together with or without an accompanying description, as is to be found in many works, then I think I am not at fault in citing such publications only in limited amount."

It has been my endeavor to give as full a description of each species considered as the material at hand would justify. When only alcoholic specimens were accessible I have mentioned the fact in the proper place.

As the development of many of the *Cestoidea* seems to be quite different, even in closely related forms, it is very important that the systematic work which is done on them be so done as to leave no doubt in the mind of the investigator what species is being described, whether the name adopted for it holds or not. Appreciating the value of figures in establishing the identity of species, I have therefore not included in this paper descriptions of any forms unless accompanied with sufficient figures to make future identification reasonably certain.

In giving the specific names of fishes mentioned in this paper, I have used the nomenclature adopted by Prof. George Brown Goode in "The Fisheries and Fishery Industries of the United States, Section I." Washington, 1884.

The illustrations which accompany this paper are the work of my wife, Margaret B. Linton.

Order CESTOIDEA.

Family DIBOTHRIIDÆ *Diesing.*

Dibothrium Rudolphi.

Tæniæ spec. of Authors.
Rhytelminthus, *Rhytis*, *Alyselminthus*, and *Helsys* Zeder.
Bothriocephalus (*Dibothrius*) Rudolphi.
Diphyllobothrium Cobbold.
Dibothrium Diesing.

Dibothrium manubriforme, sp. nov.

[Plate I, Figs. 1–4.]

Head cuneate, tetrangular, truncate in front, tapering posteriorly, constricted into a cylindrical neck-like part near posterior, then expanding so that the posterior end of the head resembles one of the anterior segments of the body. The general appearance of the head when viewed laterally is therefore somewhat like a ball-bat, the constricted part representing the handle. Two longitudinal fossæ (bothria), laterally placed, extend from the anterior part of the head to the constricted part. Each of the marginal lobes thus formed is indented at the anterior extremity by a short but deep secondary fossa, which, together with the two lateral fossæ, give the head when viewed in front a four-lobed appearance. The edges of the lobes bordering the lateral fossæ are thin-lipped and flexible; anteriorly there is a transverse elevation forming both a lateral and a marginal rim and making an obtuse angle between the front and the side of the head. The marginal lobes, when at rest, have a rounded outline, fullest in the middle, tapering posteriorly, appressed slightly anteriorly, and raised into two small eminences on each side of the secondary fossæ. The head in a marginal view is somewhat flask-shaped. Seen from the front the head is squarish, with the angles rounded and the sides deeply cleft, the clefts rounded, the lateral clefts deeper than the marginal. Immediately back of the head the segments are very narrow, and for a greater or less distance, depending on the state of contraction, maintain about the same width as the base of the head. In some individuals the small anterior segments continue much farther back from the head than in the one figured (Plate I, Fig. 1). The segments are alternately short and long. This characteristic is quite plainly marked in those segments which immediately follow the

head, is still noticeable on the median segments and also on the posterior ones, but is not so plainly marked on the latter as on the two former. In one specimen examined the first six segments did not show this alternation in size. In the next fourteen segments, however, the alternation was quite evident. The small anterior segments are terete, subtriangular in outline, narrow in front, wide behind, the length nearly equal to the greatest breadth. The succeeding segments are much broader than long. At the widest part the ratio of the breadth to the length is as much as fourteen to one. As the segments increase in width they become much crowded together and thickened. In one specimen, measuring 140mm, the segments increased in width uniformly for about 100mm from the head; from that point they remained about the same size until near the posterior end, where they began to be elongated and at the same time became narrower and much thinner. The crowding together of the median segments is not due to contraction, but seems to be a permanent characteristic of the species. In some very young specimens the same character was observed. The general form of these worms, both young and adult, was persistent. Although kept for some time in water they were not observed to change their form in any essential particular from that given in the sketches.

In alcoholic specimens a dark median line will be noticed extending from the posterior end to the middle or anterior third of the strobile. This is due to the centrally situated ovaries, which are crowded with eggs. The genital apertures are lateral and may be traced in an irregular zigzag line on one side from about the anterior third of the body. In the mature segments they are rendered obscure, if not wholly obliterated, by the mass of eggs with which the center of the segment is filled. The eggs are white, opaque, oval; length, .045mm; breadth, .03mm. Associated with these perfect eggs are masses of others which become transparent when treated with oil of cloves or other strongly refracting media. These seem to be imperfect eggs which have not become invested with the thick hard shell which covers the perfect eggs.

An adult specimen gives the following measurements:

	Millimeters.
Length of strobile	133.00
Length of first series of segments	17.00
Length of head	3.50
Breadth of head in front, widest part	1.00
Average length of segments in first series	0.50
Breadth of widest segments, median	6.50
Length of widest segments, median	0.25
Length of posterior, mature segments	1.00
Breadth of posterior, mature segments	2.50

In another specimen the head and first segments give the following measurements:

	Millimeters.
Length of strobile	140.00
Length of head and first series of segments	30.00
Length of head	3.00

	Millimeters.
Breadth of head in front, widest part	0.90
Breadth of head just behind the front rim	0.80
Breadth of marginal lobe, about the middle	0.90
Breadth of head, narrowest part	0.21
Breadth of first segment, widest (posterior) part	0.80
Breadth of first segment, narrowest (anterior) part	0.42
Length of longer alternate segments, first series	0.40
Length of shorter alternate segments, first series	0.24

The segments of the first series are sometimes notched or crenulated on the postero-lateral margin, with a single median indentation; in others the edge is but slightly waving; in others it is nearly entire.

The following measurements are from a young specimen:

	Millimeters.
Length of strobile	20.00
Length of head	2.10
Breadth of head, anterior	0.80
Breadth of head just back of anterior rim	0.60
Breadth of head, narrowest (constricted) part	0.31
Breadth of first segments, widest (posterior) part	0.50
Breadth of first segments, narrowest (anterior) part	0.28
Average length of segments, longer alternates	0.35
Average length of segments, shorter alternates	0.24
Breadth of widest segments	0.90
Average length of widest segments	0.12
Width of posterior segments	0.35
Length of posterior segments	0.36

Habitat.—Both young and adult, one specimen of the former and six of the latter, were taken from the intestine of a spear-fish (*Tetrapturus albidus* Poey), August 8, 1885, at Wood's Holl, Mass.

Dibothrium alutera, sp. nov.

[Plate I, Figs. 5–8.]

Near *Dibothrium microcephalum* Rudolphi, Diesing, Systema Helminth., i, 592. *Ibid.*, Sitzungsb., xiii, 578, Revis. Ceph., Par. 241. Wagener, Nov. Act. Nat. Cur., xxiv, Suppl., 16, 69, tab. vii, 77. Van Beneden, in Bullet. Acad. Belgique, xxii, ii, 521.

Bothriocephalus microcephalus Bellingham, Ann. Nat. Hist., xiv, 253. (Habitat, *Orthagoriscus mola.*)

Head subsagittate with rounded apex; bothria oblong, lateral; neck, none; first joints distinct, about as long as wide, becoming much shorter and crowded together, much wider than long; genital apertures unknown.

Habitat.—File Fish (*Alutera Schœpfii*), Wood's Holl, Mass., August, 1884; 104 specimens from intestines of a single fish.

These specimens were all immature, none of them had the genital apertures developed. They ranged in length from 20^{mm} to 94^{mm}. The bothria in the smaller specimens are convex (Fig. 5), the central convex portions thin and transparent. A lateral view shows the bothria

to be much narrower than the first joint, with curved regular outlines, except at the posterior edge, where there is a shallow notch. The front of the head is bluntly conical, expanding quickly, then moderately contracted, making a kind of knob or button at the apex; this knob is nearly circular. Measurements showed that the lateral diameter was but little greater than the marginal. In the larger specimens this convexity of the bothria had entirely disappeared, the thin membrane having collapsed and the typical fossæ of the *Dibothriæ* make their appearance. In the larger specimens, also, the bothria are much shorter in proportion to their width than in the smaller specimens (Fig. 7). The first segments are distinct, length as great or even greater than the width, triangular. The median and posterior segments are much crowded, width as much as or even more than ten times the length, alternately long and short, sometimes roughened by transverse wrinkles toward the posterior end. Posterior end bluntly rounded (Fig. 8).

The following measurements are from alcoholic specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of strobile	55.00	67.00	94.00	.....
Length of head	0.60	.....	0.64	0.64
Diameter of head, lateral apex	0.34	0.25	0.33	0.34
Diameter of head, marginal apex	0.30	0.25	0.33	0.34
Breadth of bothrium, widest part	0.42	0.40	0.52	0.54
Greatest marginal diameter of head	0.46	.....	.....	.....
Lateral diameter of first segment	0.58	0.70	0.66	0.68
Marginal diameter of first segment	0.34	0.40	.....	.....
Length of first segment	0.34	.....	0.40	.....
Greatest width of strobile	2.50	1.60	1.80	.....
Average length of segments near posterior	0.17	.....	0.15	.....
Length of posterior segment	0.20	.....	.....	.....
Breadth of posterior segment	1.40	.....	0.40	.....

It will be seen upon comparing Figs. 6 and 7 that there is great variety of form to be found in the bothria of these worms. Other forms could be given, but it is believed that those chosen for illustration are sufficiently typical to prevent mistakes in identification. In many specimens the convex outline of the bothria is lost, while the other proportions of Figs. 5 and 6 are preserved. In cases where care is not taken the preserving fluid may distort the bothria.

I did not observe any indication of the hooks on the head, mentioned by Wagener for *D. microcephalum* (Entwickelung der Cestoden, p. 69, tab. vii, figs. 77 and 77*a*). The resemblance of this worm to Wagener's figure is sufficiently close to indicate a probable identity. The close relationship of the hosts, *Orthagoriscus mola* and *Alutera Schœpfii*, does not lessen this probability.

In the absence of positive proof of such identity, which can be obtained only by observing some other stages of development, I think it best to classify this worm as a new species with the provisional name *D. aluteræ.*

Family TETRABOTHRIIDÆ.

ECHENEIBOTHRIUM Van Beneden.

Echeneibothrium variabile Van Beneden.

[Plate I, Figs. 9–13.]

Echeneibothrium variabile Van Beneden, Mém. Acad. Belgique, xxv, 117, tab. iii, 1–4, 6–15. G. R. Wagener, Nov. Act. Nat. Cur., xxiv, Suppl., 85, tab. xxii, 280–282. Van Beneden, Mém. Vers Intest., 122 and 366, tab. xv, 6–8. Diesing, Revis. der Ceph. Ab. Par., 267. Olsson, Lunds Univers Arssk., tom. iii, 38, 40, tab. i, 15, 16.

Tetrabothrium (*Echeneibothrium*) *variabile* Diesing, in Sitzungsb., xiii, 1854, 581.

Larval state, Van Beneden, Mém. Acad. Belgique, xxv, tab. iii, 5. Diesing, Sitzungsb. der kais. Akad., xiii, 1854, 562. G. R. Wagener, *l. c.*, 85, tab. xxii, 279. Van Beneden, Mém. Vers Intest., 122, tab. xv, 5.

Bothriocephalus sphærocephalus? Deslongchamps, Encycl. Méth., ii, 150.

Echeneibothrium sphærocephalum Diesing, Revis. der Ceph. Par., 267.

The characters given for this species by Diesing, following Van Beneden, are:

Bothria four, pedicellate and highly versatile, at times linear or oval, at others cochleariform or calyciform, with a few transverse costæ, and divided into several loculi by a longitudinal partition. Muscular proboscis (myzorhynchus) large, subglobose, retractile, with a circular aperture (os) in the apex. Neck long. Anterior segments of body broader than long, median quadrate, ultimate oval. Genital apertures marginal, alternate. Penis armed with spines, scarcely bristly at base. Length as much as 100mm.

In the latter part of August, 1884, I obtained several specimens of *Echeneibothria* from the spiral valve of the common Skate (*Raia erinacea*) which I have for the present referred to *E. variabile* Van Beneden. Some of the specimens possess characters which are given by Diesing as belonging to *E. sphærocephalum* Dies. (Revis. der. Ceph. Par., 267). It is probable, however, that these two species are identical, as indicated by Diesing: "Species hæc (*E. variabile*) cum præcedente (*E. sphærocephalum*) fortasse identica."

A few sketches and measurements were made of the specimens while they were still alive, but a pressure of other duties prevented a careful study of them then. When I found time to study them carefully they had lain for some time in alcohol and many of the segments had separated. There are two distinct types of head, one represented in Fig. 9, made from the living specimen; the other represented in Fig. 13, made from an alcoholic specimen. Other alcoholic specimens are identical in form with that shown in Fig. 9. In the first mentioned the bothria are somewhat oval; pedicels moderately extended; the border of the sucking disks thickened, marked with radiating lines, and gathered or puckered into a few large folds. The proboscis is globose, re-

tractile. When the living specimen was viewed from the apex the aperture (os) could be seen surrounded by many radiating lines like the radiating muscles of the iris. In a side view of a mounted specimen a globular body about 0.2mm in diameter can be seen lying in the center of the proboscis and about 0.1mm from the apex. This globular mass has an aperture which lies opposite the aperture of the proboscis. It probably represents the true apex of the myzorhynchus retracted. The head behind the bothria is elongated into a neck-like part, which joins the true neck or jointless portion of the body by a definite articulation, which bears a faint resemblance to a ball-and-socket joint, in which the anterior part of the neck represents the "ball." There is also a difference in tissue, the neck having, besides longitudinal fibers, transverse fibers and many granular cells, while the neck-like portion of the head appears to be composed almost entirely of fibrous tissue arranged longitudinally.

In the other type the pedicels of the bothria are inflated and somewhat globose; the thickened border of the disk is not so much folded as in the first. The head behind the bothria is short and turgid. These differences, although striking when extreme cases are considered, are none of them so profound but that they may be accounted for by supposing them to represent different degrees of contraction. The bothria in the living worm are susceptible of great variety of form.

The segments begin from 1 to 2mm back of the head. At first they are much broader than long, subsequently they become quadrate, then longer than broad. As the segments begin to mature they show a tendency to become narrowed anteriorly, with convex margins. A few of the extreme posterior segments are four times as long as broad, obtuse-pointed in front, posteriorly attenuate, with a truncate termination. The genital apertures are marginal, opening a little behind the middle. In some they are not exactly on the margin, but may be seen, in a lateral view, to be situated near the margin and running obliquely toward the center of the segment. The penis was retracted in all the specimens examined. It could be seen lying coiled up in the angle formed by the vagina where the latter turns abruptly from the middle of the segment towards the margin. The vagina could be traced from the ovaries in the posterior part of the segment along the median line until it reaches a point nearly opposite the marginal opening, where it turns abruptly towards the margin and opens immediately in front of the penis. The vas deferens is represented by a convoluted mass of tubes in the center of the segment. The anterior part of the segment is filled with large globular masses (ova). These are surrounded by a thick transparent membrane, and have a granular interior. A layer of oblong granular masses, smaller than the interior globular masses, surrounds the latter. This layer is adjacent to the marginal wall of the segment and the masses are at right angles to it.

In some specimens the median and posterior segments are very irregular in shape. This irregularity is sometimes produced by the appar-

ent occurrence of an imperfect segment of triangular shape interjected between two others which are but slightly irregular; in other cases it has the appearance of two segments, one lying diagonally across the other and the two, as it were, welded together. Measurements of the head are not satisfactory on account of the extreme contractility of that part.

The following measurements were made from a mounted specimen corresponding in position and appearance with Fig. 9:

	Millimeters.
From tip to tip of extended bothria	1.48
From apex of proboscis (retracted) to neck	0.96
Breadth of neck	0.20
Breadth of first segment	0.20
Length of first segment	0.04
Distance from head to first segment	1.40
Length of a mature segment	2.60
Breadth of a mature segment	0.60
Length of segment near posterior	1.20
Breadth of segment near posterior	0.50
Length of longest living strobile	108.00

Habitat added: Common Skate (*Raia erinacea*), spiral intestine. Wood's Holl, Mass., August 25, 1884.

SPONGIOBOTHRIUM,* gen. nov.

Body articulate, tæniæform. Head separated from the body by a neck. Bothria four, opposite, pediceled, broken up into lacinio-crispate folds, which are transversely costate. Unarmed; auxiliary acetabulum none; terminal papilla none. Genital apertures marginal.

This genus combines many of the characters of *Echeneibothrium* Van Beneden and *Phyllobothrium* Van Beneden. It differs from the former in the laciniæ of the bothria and in the absence of a terminal haustellum; from the latter in having pediceled instead of sessile bothria, and in the transverse costæ on the bothria.

Spongiobothrium variabile, gen. et sp. nov.

[Plate II, Figs. 13–19.]

Body articulate, tæniæform. Head separated from the body by a short neck, subquadrangular, tapering posteriorly, continuing at the anterior angles into four bothria. The bothria are pediceled and on their outer faces and borders are broken up into a number of delicate frill-like laciniæ, which are sometimes gathered into a more or less compact mass of crisp, puckered, or purse-like folds (Fig. 15) and sometimes expanded into long, curved, auriculate, or leaf-like flaps (Fig. 16). These are marked by transverse, parallel costæ which originate from a middle portion like the midrib of a leaf. There is no trace of either a

*Σπόγγος = a sponge or mop.

terminal papilla or auxiliary acetabulum. The neck, or unjointed part of the body, is short. In some the transverse striæ, which indicate the beginning of segments, were discernible almost immediately back of the head. The first segments are usually crowded, broader than long; subsequently they increase in length and become considerably longer; than broad. In some of the ultimate segments the length is four or five times that of the breadth. The shape of the mature and nearly mature proglottides is very various.

This irregularity of shape is to be found in the living specimens as much as in those which have been preserved in alcohol. The most usual shape for the mature segments to assume is subquadrangular, somewhat contracted about the posterior third in the vicinity of the genital openings, expanding in front of this; the anterior end contracted into a short constricted neck where it joins the preceding segment. Sometimes this constriction occurs at the posterior instead of the anterior end of the segment. The ovaries are two sets of radiating tubes situated in the posterior end of the segment. The anterior half of the mature segments is crowded with globular masses (testes). These masses fill at least the anterior two-thirds of the adolescent segments. In the mature segments of all the specimens I have yet examined the center is filled with a convoluted mass, consisting of the retracted penis and the vas deferens, with perhaps the vagina and a portion of the oviduct. The extremely long and convoluted vas deferens is found protruding from the ruptured side of some of the segments which have been preserved in alcohol. This worm is remarkable for the slight change which it experiences when preserved in alcohol. Even the extremely delicate leaf-like folds of the bothria were not observed to curl up or shrivel when subjected to moderately strong alcohol. Fig. 15, Plate II, is a sketch made of a living specimen. I have since mounted the same individuals for permanent preservation. In the various processes of dehydrating with alcohol, staining with eosin, rendering transparent with oil of cloves, and afterwards mounting in Canada balsam, there has not been any shrinking or change of form, at least to any appreciable extent.

The water-vascular system is plainly indicated by two rather large tubes, which in the neck and anterior part of the body are sinuous, and each situated about as far from the other as it is from the nearest edge of the strobile. In subsequent segments they become widely separated from each other on account of the interposed ova and genital organs.

The substance of the head and pedicels of the bothria is for the most part fibrous tissue. The conical portion of the head is thus sharply marked off from the so-called neck. While the former is made up largely of fibrous tissue, the latter is granular, with but few longitudinal fibers. This feature can be easily brought out in preserved specimens by simple staining.

The following measurements were taken from mounted specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of specimen	37.00	21.60	23.00	74.00
Length of bothria	0.96	0.90	.....	.....
Breadth of head—side	1.35	1.60	.....	.....
Breadth of head across the top	.....	.....	1.40	2.00
Length of one bothrium, expanded	.....	.....	3.00	.....
Breadth of neck	0.20	0.16	0.20	0.24
Distance from head to first striæ	.....	.....	1.50	1.00
Distance from head to first distinct segment	1.80	1.40	2.00	2.60
Length of first segment	0.10	0.08	0.16	0.14
Breadth of first segment	0.20	0.26	0.24	0.32
Length of maturing segment	1.60	0.54	(*)	2.00
Breadth of maturing segment	0.32	0.24†	.....	0.42
Length of posterior segment	0.74	0.80	.....	1.56
Breadth of posterior segment	0.50	0.46	.....	0.86

*Maturing segments very irregular, some long and narrow, others thick and short with rounded corners. †Variable.

Additional measurements of No. 4.

	Length.	Breadth.
	mm.	*mm.*
Segment 4mm from head	0.20	0.32
Segment 20mm from head	1.00	0.34
Segment 30mm from head	1.50	0.40
Segment 45mm from head	2.00	0.42
Segment near posterior end	2.40	0.70
Last segment but one	1.76	0.80
Last segment	1.56	0.86
Free segment	2.50	0.80
Free segment	3.00	0.80

Habitat.—Sting Ray (*Trygon centrura*), spiral intestine. Wood's Holl, Mass., August, 1884.

PHYLLOBOTHRIUM Van Beneden.

Phyllobothrium thysanocephalum,* sp. nov.

[Plate II, Figs. 1-12.]

In its sexually mature or strobile condition, this Cestode varies in length from 300mm to 1m. The head, as best seen in young specimens, has four bothria, which are quite early lobed and crisped and folded at the edges. In the adult these bothria are deeply lobed, so that even in a cross-section (Fig. 10) it is extremely difficult to make out the four primary lobes. The frilled, crisped, or ruffled structure of the bothria gives to the head, when at rest, a singularly striking resemblance to the short, imperfect branches which form the head in the cauliflower. The neck, or jointless part of the body, is very long. In one specimen, which measures 840mm in length, the first joints appear about 360mm back of the head. Immediately back of the bothria the head is slightly swollen and subcylindrical, and in alcoholic specimens nearly as wide as the bothria; in the living worm about three-fifths the width of the bothria.

*Θύσανος = a tassel.

The neck is continuous with the head, slightly flattened, and tapers away from the head very gradually in fully grown specimens, so gradually, that its progress cannot be noted, except by comparing the width of the proglottides with that of the neck. The neck is marked with longitudinal rugæ, which continue well back on the forming proglottides (Figs. 1, 2). Where the transverse striæ, which mark the forming proglottides, begin, the surface of the body presents a rough, checkered appearance, due to these two systems of grooves, which is quite characteristic, and may serve to identify a fragment of one of these worms when neither head nor mature proglottis is present.

Proglottides, before they become free, are much broader than long, and each has a short, free posterior border, which becomes the rim or border mentioned in the description of the free proglottis. Penis very long, with a bulbous enlargement at the base. Near the posterior end the segments become rounded at the corners and somewhat elongated, until they graduate into the shape which is characteristic of the mature free joints.

Free proglottides (Figs. 4, 5) about twice as long as broad, very changeable in form, but in general rounded anteriorly; the extreme anterior end prolonged into a contractile papilla, which acts somewhat as a sucking-disk in aid of locomotion; posterior end truncate, with a narrow rim or border marked off from the basal edge by the transverse water-vessel. Sexual apertures marginal, opening a little back of the middle point. Penis very long; when erected, longer than the proglottis. Vagina opening immediately in front of the penis, flaring slightly at the mouth, quickly contracted into a short cylindrical tube, then expanding, finally reduced to a narrow tube, which runs anteriorly alongside a central clear space, enters the latter, and near its anterior end turns sharply, and runs back along the middle of the clear space until it unites with the ovaries in the posterior part of the proglottis.

Good preparations of the mature proglottides were obtained by subjecting them to slight pressure between two cover-glasses held in place by a spring wire-clip and hardened while in this position. When segments so prepared were afterwards stained, made transparent, and mounted, they were free from wrinkles or distortions, and showed the internal anatomy as well, indeed better, for topographical purposes, than could be shown with thin sections.

The chyle in the spiral intestine of the host, Tiger Shark (*Galeocerdo tigrinus*), swarmed with free proglottides, which were quite active. They had powers of independent movement and locomotion which gave them much the appearance of Trematods.

About twenty specimens in the strobile condition, but representing three stages of development, together with great numbers of free proglottides were found in the spiral intestine of a Tiger Shark (*G. tigrinus*). The larger adult specimens varied in length from one-half to one meter.

Measurements made on the largest specimen were as follows:

Total length of strobile	meter	1
Breadth of head, lateral	millimeter	15
Thickness of head, marginal	do	6
Breadth of neck	do	9
Breadth of posterior segment	do	5
Length of posterior segment	do	2

In this specimen all the mature proglottides had evidently become separated from the strobile. On another specimen, measuring 580mm in length, the posterior proglottides were mature, and measured 5mm in length and $2\frac{1}{2}$mm in breadth.

Measurements of free living segments give the following proportions: Length, 8mm; breadth, 4 to 4.5mm; length of penis, 4mm+.

A second and younger stage was represented by specimens ranging in length from 190mm to 230mm. These differed from the next stage, described below, in size and in having a more or less evident beginning of a jointed condition. This, in the smaller forms of this second group, was indicated by tolerably distinct waving transverse lines. The largest specimen of this group, 230mm in length, although tapering to a point at the posterior end like the others, had distinct segments for the last 30mm.

Another group, consisting of quite young specimens, ranging in length from 31mm to 57mm, represented a third stage in the development of this worm (Figs. 7, 8). These are evidently the young of this species.

Measurements of one of them give the following dimensions:

	Millimeters.
Length of specimen	41.00
Length of head	1.50
Breadth of head	2.25
Length of rostellum	0.50
Breadth of neck just back of head	1.00
Breadth of posterior extremity	0.20

The neck increases slightly for a short distance back of the head. The body then tapers gradually and uniformly to the posterior end. In this group there is no sign of joints. Most of the specimens, particularly after they have been preserved in alcohol, have a much more compact arrangement of the folds of the bothria than appears in Fig. 7, which was sketched from a living specimen, one of the smallest of the lot. In larger specimens of this group the head is subglobose, with the edges of the bothria in crisp, closely lying folds, so that it is very difficult to make out the number of lobes of the bothria or to determine whether the latter are pediceled or sessile. The bothria are marginal, sessile, or on very short pedicels, each divided into at least two secondary lobes, which ultimately become a mass of crisp folds. In the center of the head, placed anteriorly, is a short chitinous rostellum on a pedicel of soft connection tissue (Figs. 7, 7*a*, 7*b*). Seen from the front this rostellum is quadrate, and presents to view four crescent-shaped bodies (Fig. 7*a*) with their convexities turned inward and inclosing a clear

space, in the center of which is a granular elevation. The tips of the horns of these crescents are sharp-pointed, and form a circle of eight hooks, which surrounds the tip of the rostellum. When this rostellum is viewed from the side, each crescent is seen to be the recurved anterior border of an oblong or triangular trough-like plate. These four triangular plates occupy much the same relative position with respect to each other as the jaws in *Echinus*, and suggest the "lantern" of that animal. This proboscis was observed in all of the smaller specimens and in some of the half-grown ones, but had been lost by all of the larger specimens. It seems to have but a feeble attachment to the head, and became detached from several specimens while they were being examined. The length of this rostellum in the half-grown specimens was about the same as that found in the smaller specimens, viz, about 0.5^{mm}.

In a series of transverse sections made of a head of one of the larger specimens, it was noticed that there was a circular aperture in the sections of the anterior part of the head, which doubtless marks the place where the fleshy pedicel of the rostellum was inserted. The primary lobes of the bothria spring from a central muscular portion of the head (Figs. 9, 10), and consist of fascicles of muscular fibers which extend into the secondary and tertiary divisions. The crisped appearance of the head is due to minute crimped or frilled divisions of the lobes, and not to the crisping or curling of the free borders of the lobes, as in *P. lactuca* Van Beneden. The solid, central part of the head which serves as a support for the so-called bothria, is pointed anteriorly, where the lobes, in transverse section, appear to radiate from a common point. It is on this extremity of the head that the base of the rostellum is situated. This central portion or core of the head increases in size until at the base of the head it has the dimensions given in the measurements as the thickness and width of the neck. A transverse section of the basal part of the head or of the neck, in the smaller specimens, is rhomboidal (Fig. 12). In the larger specimens the breadth of the neck is greater in proportion to the thickness than is the case in the smaller specimens. In Fig. 10 a transverse section is shown of the head of an adult at about the anterior third. The central core of the head at this point is quadrate, and but two of the vessels of the water-vascular system appear. Sections made transversely through the middle of the head show the central core to be oblong (Fig. 9). The central part of such a section is a clear space with a few connective tissue fibers and granular masses in it. Both fibers and granules become more crowded in the vicinity of the longitudinal vessels which are sharply defined in cross-section. A transverse vessel was observed in a section through the head, which connected the two inner longitudinal vessels. The central clear space is limited by a dense layer of muscular and connective tissue fibers, which make a circular layer of tissue that can be traced back into the neck where it becomes much

elongated and is surrounded by a layer of longitudinal fibers. In the head, outside of the ring of tissue which limits the central space, there may be seen in the sections both the cut ends of longitudinal fibers and also the beginning of transverse fibers, which extend out into the lobes of the head in dense fascicles.

The color of living specimens is translucent white, with sometimes a faint bluish tint. Alcoholic specimens are opaque, white, faintly yellowish, or cream-tinted.

This worm is near *P. lactuca* Van Beneden (Les Vers Cestoides, Pl. IV, Figs. 1–7), but differs from it in the following characters:

The neck and anterior unjointed part of the body are broader than the posterior mature segments. They are not so represented by Van Beneden for *P. lactuca*. The genital apertures instead of opening opposite the anterior third of the body of the proglottis, as in *P. lactuca*, open nearly opposite the posterior third. No mention is made of a rostellum in *P. lactuca*, but this difference alone would not justify the creation of a new specific name, since the rostellum could be easily overlooked, or if only mature strobiles were found, it is very probable that the rostella would have been lost.

Habitat.—Tiger Shark (*Galeocerdo tigrinus*), adult, half grown, and young specimens together in spiral intestine. July 23, 1885, Wood's Holl, Mass.

Orygmatobothrium Diesing.

Bothriocephali spec. Siebold.
Anthobothrii spec. Van Beneden.
Tetrabothrii (*Anthobothrii*) spec. Molin.

Orygmatobothrium angustum, sp. nov.

[Plate III, Figs. 1–3.]

Head round-pointed in front with four bothria, which are unarmed, hollowed out or boat-shaped when at rest, with anterior extremities, round-pointed, slightly appressed and projecting in front and surmounted at the apex by a supplemental disk (auxiliary acetabulum). A second, larger disk lies in the center of the hollow of each bothrium. The posterior end of each is rounded, broader than anterior end, usually flaring away from the neck. Border of bothria raised, somewhat thickened with entire outline. Pedicels short, neck long, narrow, marked with transverse, closely parallel, slightly notched or crenulate rings, which give a serrate outline to the edge. Segments long and narrow, mature segments five times as long as wide. Genital apertures marginal. This worm is near *O. versatile* Dies. (Revis. der Ceph. Ab. Par., 276.)*

**Bothriocephalus auriculatus* Siebold, Zeitschrift f. Wissensch. Zool., ii, 218, tab. xv, 12.
Anthobothrium musteli Van Beneden, Mém. Acad. Belgique, xxv, 126 and 190, tab. vii, 1.
Tetrabothrium (*Orygmatobothrium*) *versatile* Diesing, Sitzungsb., xiii, 582.
Tetrabothrium musteli Van Beneden, Wagener, Nov. Act. Nat. Cur., xxiv, Suppl., 85, tab. xxii, 276–278.

It differs from *O. versatile*, however, in being much smaller, and in the proportions of the segments. In *O. versatile* the segments are square, while in *O. angustum* all the segments are long and narrow.

The following measurements were made from mounted specimens:

Dimensions:	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length of strobile	17.00	18.00	20.00
Length of bothrium	0.64	.....	.....
Breadth of bothrium, widest part	0.32	.....	.....
Breadth of neck near head	0.14	.....	.....
Length of neck	5.00	.....	.....
Length of posterior segment	2.20	2.00	2.46
Breadth of posterior segment	0.44	0.28	0.54

The anterior supplemental disk (auxiliary acetabulum) is small and circular and is quite manifest. I must confess, however, that the identification of the other was not wholly satisfactory. An oval disk was distinguished in a few. In some heads stained with carmine, eosin, and hæmatoxylon, respectively, they cannot be distinguished. At about the anterior third the face of each bothrium, in the stained specimens, is crossed by a curved fibrous band which is concave in front. This band lies in the tissue of the bothrium and is not raised on the surface. It seems to be connected with another band lying farther back in the bothrium and deeper in its substance. If they are connected they probably make the oval border of the second disk. If one is to judge from the specimens in this lot—about fifteen in number—the secondary disk in the center of the bothria is an extreme doubtful character. It is plainly different in its nature from the anterior disk which was differentiated from the adjacent tissue clearly, both in unstained and stained specimens. The fine transverse striæ on the neck, which may be distinguished also on the mature proglottides, are a more characteristic feature of this worm than the second disk (auxiliary acetabulum).

The genital organs open nearly opposite the anterior fourth of the proglottis, on the margin.

The vagina can be traced from the posterior end of the segment, where it originates as a coiled tube, lying between the two marginally placed ovaries. It lies along the central line of the segment, until a short distance in front of a point opposite the vaginal opening, where it turns, forming a crook-shaped curve, and opens in front of the penis. The latter organ and the testis lie in the curve of the crook.

Habitat.—Dusky Shark (*Carcharias obscurus*), in spiral intestine. Wood's Holl, Mass., August, 1884.

Crossobothrium,* gen. nov.

Body articulated, slender, flattened, subquadrate; neck short or none; bothria four, opposite, pediceled, unarmed, each provided with

*Κροσσοί = a border, fringe.

one auxiliary acetabulum on the anterior border. Faces of bothria with a raised rim or border, which becomes more or less free, cut, or frilled as the worm grows weak, or when placed in fresh water or alcohol.

Genital apertures, both male and female, marginal. Development not known.

This genus is closely allied to *Phyllobothrium* Van Beneden, but differs from it in having the bothria pediceled instead of sessile, and in the absence of a distinct neck.

Crossobothrium laciniatum bears some resemblance to *Anthobothrium cornucopia* Van Ben., particularly in the shape of the segments, but differs from it in having distinct auxiliary acetabula, and in having the segments begin immediately behind the head. The bothria are not so long-pediceled as in *A. cornucopia*. The bothria, especially in living specimens in sea-water, bear a superficial resemblance to *Oxygmatobothrium versatile* Dies. (*Anthobothrium musteli* Van Ben.), but there is no trace of a second auxiliary acetabulum on the face of the bothria. The habit of the strobile is, furthermore, quite different from *O. versatile* Dies.

Crossobothrium laciniatum, gen. et sp. nov.

[Plate III, Figs. 4–18.]

Body articulated, slightly flattened; cross-section of segments near head quadrangular; ratio of thickness to breadth about 1 to 2. The segments begin immediately behind the head, each is characterized by having four marginal flaps on the posterior border. The anterior segments in the larger specimens, for a distance of 20 or 30^{mm} back of the head, are about as broad as long, the posterior angles projecting into prominent triangular flaps, which, in a few cases, stand out almost at right angles to the face of the segments, but are usually appressed. The bodies of the segments are translucent, the posterior borders and projecting flaps opaque and ivory white in color. This feature is especially noticeable in specimens which have lain a few minutes in fresh water. Behind these slender anterior segments the remaining segments increase in breadth without increasing in length. Near the middle of the strobile the ratio of length to breadth is about 2 to 9. The median segments are flat and the triangular flaps develop into broad, rounded lobes. These lobes form a free border, which is sometimes reflexed and usually emarginate on the lateral edge.

The posterior segments are considerably lengthened; length about 1.5^{mm}; breadth about 2^{mm}, flattened; outline usually rounded or waving, narrower in front than behind, emarginate on lateral edge. (Plate III, Figs. 7, 8.) The shape of the free proglottides varies greatly while they are living, but at rest or in alcoholic specimens it is quite uniform.

The postero-lateral border is profoundly emarginate; the outline of the margin concave behind, then convex throughout the greater part of the length, concave again near the anterior end, which is extended into

a rounded knob. (Plate III, Fig. 12.) In some free segments with a less rounded outline the shape is much like that of a steeple-crown hat with a drooping, flexible rim. Length of a mature free proglottis 2.8^{mm}; breadth of posterior edge, measured from tip to tip of the reflexed border, 2.1^{mm}; breadth of posterior, exclusive of reflexed border, 1.7^{mm}, tapering to an obtuse point in front. The bothria are four in number, marginal, short-pediceled, unarmed, each provided with a single supplemental disk (auxiliary acetabulum Diesing) on the anterior border.

The bothria of living, active specimens undergo such profound changes upon being transferred from sea-water to fresh water that it is necessary, in order to guard against mistakes, to give separate descriptions for each condition.

If allowed to lie in sea-water, these worms continue active for several hours. Some, after lying for twenty-four hours in sea-water, were still quite active, moving their bothria incessantly and alternately contracting and elongating the body and throwing it into irregular kinks and folds. The bothria are extremely mobile. They are usually hollowed out or boat-shaped on the face, bounded by a thickened rim or border which merges into the auxiliary acetabulum in front. In a resting position they are oval in shape, more or less narrowed in front and rounded posteriorly. Locomotion is effected by thrusting the bothria forward and attaching the face as a sucking disk to the surface over which the worm is moving, and thus dragging the body along. The bothria are usually thrust forward in pairs, the two which would stand diagonally opposite in a cross-section constituting a pair. They are thrust forward bodily and at the same time become greatly elongated in front. This attenuated part of each is frequently bent outward at right angles, so that the two stand apart like a pair of recurved horns. (Plate III, Fig. 11.) The remaining pair of bothria meanwhile is some distance back of the forward pair and much contracted longitudinally, the apex of each being a short distance behind the rounded papillary apex of the head. Each bothrium when thrust forward and attenuated is tipped by the auxiliary acetabulum, which forms a sort of sucker. Each individual bothrium, while active, resembles in its motions the movements of a common leech. The resemblance is heightened by the auxiliary acetabulum, which has much the appearance and is used in the same manner as the anterior sucker of some leeches. Often the posterior ends of the bothria bend outward and forward until they almost meet the recurved anterior ends. The under bothrium was noticed sometimes adhering to the bottom of the watch-glass in which the specimen was lying and spread out into a broad, thin, circular disk. In this case all appearance of a thickened border to the face of the bothrium was obliterated. Behind the bothria the head contracts suddenly into a short, neck-like part, which is about the same size and shape as the first segments, and, like them, is terminated by four triangular lappets at each of the four angles. This latter feature

is unchanged either by fresh water or alcohol. When placed in fresh water the bothria become profoundly modified. Two distinct forms were observed; in one lot the specimens measuring from 112 to 124^{mm} in length, the breadth of the head is 3.5^{mm}, its length is 1.5^{mm}. The bothria are trumpet-shaped, very transparent and delicate, the outer face convex and surrounded by a delicate, narrow, raised border. It is circular except at the anterior edge, where it is broadly indented and interrupted by a circular, opaque disk (the auxiliary acetabulum). (Plate III, Fig. 6.)

In a second lot, the individuals of which measure from 95 to 250^{mm} in length, the breadth of the head is about 2^{mm}, its length 1.5^{mm}. (In an active specimen in sea-water the length of the head is about one-half of the breadth.) The rim or border of the bothria is irregular, broken, or ragged in outline, which gives to the head a crisped appearance, so as to suggest upon superficial examination the genus *Phyllobothrium* (Plate III, Fig. 5). The auxiliary acetabula are often concealed by the ragged edges of the bothria, but they can be plainly seen in a top view of the head (Plate III, Fig. 15).

Both the male and female apertures are marginal. It is often very difficult to make out the course of the vagina. By compressing a free proglottis, or better by flattening a proglottis between two glass slips and hardening it while in that position, and afterwards staining and transferring to glycerine or oil of cloves, the topography of the genital apparatus can be made out. At first I was wholly at fault with regard to the position of the vaginal opening, having been misled by the lateral aperture which is usually to be seen in the mature segments and from which the ova are discharged. This aperture resembles the vaginal opening in many of the *Dibothriæ*. It is found only in the posterior segments of the largest specimens and in the free proglottides. It is not always present even in these, as it is not unusual to find a free proglottis without the lateral aperture. When such a proglottis is examined its central part will be found to be filled with ova, often to such an extent that the lateral face of the proglottis is swollen in the middle so as to have a convex outline. In this case the lateral aperture may be seen already outlined but closed by a thin membrane, upon the rupture of which the eggs make their escape. The ovary is a lobed, glandular body lying near the posterior end of the proglottis. The vagina after leaving the ovary follows the median line but a short distance. It bends in a uniform curve towards the margin, and in its outer part lies immediately in front of the penis and very close to it. In the specimens which I have examined the course of the vagina as it approached the margin could not be made out until after it was differentiated by staining with carmine. The marginal aperture of the vagina is very small and is situated immediately in front of the penis. When the latter is retracted the two genital apertures seem to have the same marginal opening. The penis is long and slender. In some cases it was

found protruding as much as 0.5mm. It is covered with minute spines whose length is about one eighth the breadth of the penis. The vas deferens is a long convoluted tube lying for the most part a little in front of the center of the proglottis. The central part of the proglottis around the ova is filled with the large glandular masses of the testes. The longitudinal vessels of the water-vascular system can usually be distinguished and between them and the margin, on each side, a series of granular masses, more opaque and smaller than the masses which make up the testes, extending to the ovary and widening in the vicinity of that organ. The lateral aperature for the discharge of eggs is situated a little way back of the middle and is surrounded by a low border or lip. It is oval in outline, the longer axis coinciding with the longitudinal axis of the segment and equal to about one-eighth the length of the segment. Its posterior edge is at about the posterior third of the segment and nearly opposite the marginal opening of the generative organs.

The following measurements were made upon living specimens which had lain for a few hours in fresh water:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of strobile	100.00	142.00	195.00	212.00
Breadth of head	1.7	1.90	1.80	1.8
Length of head	1.4	1.50	1.45	1.5
Breadth of segments near head, excluding projecting flaps	0.6	0.56	0.70	0.7
Length of segments near head	0.7	0.35	0.50	0.7
Breadth of posterior segments	1.7	1.26	1.90	1.8
Length of posterior segments	1.2	1.26	1.60	1.4

The following measurements are from a segment which became detached from a strobile while still living and active in sea-water:

	Millimeters.
Length	3.10
Breadth in front	1.05
Breadth, middle	2.45
Breadth, posterior end	2.10
Length of penis	0.35
Breadth of penis	0.0875
Length of spines on penis	0.0100
Diameter of ova	0.0254

The breadth given above is approximate, as the segment was constantly changing its shape; the penis was only partly everted.

The following measurements are from a young specimen, in fresh water:

	Millimeters.
Entire length	20.00
Length of head	1.20
Breadth of head	1.80
Length of anterior segments	0.10
Breadth of anterior segments	0.30
Length of median segments	0.07
Breadth of median segments	0.90

Posterior segments but little larger than anterior.

Several young specimens were obtained, measuring from 5 to 20mm in length. In these the bothria were identical in shape and habit with those of the adult. In the younger specimens, however, the part of the head to which the bothria are attached was proportionally larger than it is in the adult. In the larger specimens of young the laciniate segments occurred throughout the entire length; in smaller specimens they occurred only near the head and at the posterior end, while the intermediate parts of the strobile were unsegmented or marked with faint transverse lines. In many of the smallest forms there were no laciniate segments, while the posterior end of the strobile carried a number of elongated segment-like bodies, totally unlike the segments of the adult. These pseudo-segments are evidently evanescent. (Plate III, Fig. 17.)

Habitat.—Sand Shark (*Odontaspis littoralis*), in spiral intestine, young and adult together, abundant, chyle swarming with free proglottides. July and August, Wood's Holl, Mass.

PHOREIOBOTHRIUM,* gen. nov.

Near *Cylindrophorus* Diesing.
Tetrabothrii Spec. Wagener.
Cylindrophorus typicus Diesing, Revis. d. Ceph. Ab. Par., p. 264.
Tetrabothrium Carchariæ Rondoletii Wagener, Nov. Act. Nat. Cur., xxiv, Suppl. 4 and 84, tab. xxii, 270–273; Statu larvæ Wagener, l. c. 4 and 84, tab. xxi, 266–268, tab. xxii, 269.
"Genus hoc insufficienter cognitum provisorio modo nomine Cylindrophori notavi" Diesing.

Body elongated, articulate. Head separated from the body by a neck. Bothria four, opposite, tubular, parallel, entire, each armed with compound hooks and provided with one supplemental disk (auxiliary acetabulum) in front. Minute spines on neck, or on neck and body. Genital apertures marginal.

Phoreiobothrium lasium,† gen. et spec. nov.

[Plate IV, Figs. 24–29.]

Head separated from the body by a neck. Bothria four, marginal, flat-tubular, subrectangular in outline, each with two compound hooks placed anteriorly, and one auxiliary acetabulum in front of hooks near the lateral edge of the bothrium. Face of the bothria hollowed out, with a thickened or raised border, so that each bothrium resembles a shallow tray. Inner edges of bothria united by a thin membrane, in which lie bands of fibrous tissue. Posterior end of the bothria elliptical, with a thickened ring or border, and marked with striæ parallel with the smaller diameter. These striæ, when highly magnified, prove to be low ridges, which give to the end of a bothrium the appearance of a coarse rasp. These striæ or ridges are not seen plainly unless the

* Φορεῖον = a tray.
† λάσιος = bristly.

bothria are reflexed. Neck flattened, rather slender, increasing uniformly backwards and merging imperceptibly into the jointed body, covered, sometimes sparsely, sometimes thickly, with very small, straight, sharp, bristle-like spines. The body has at first an unbroken outline, the square segments being indicated simply by fine, transverse lines. Farther back the segments become elongated, with the corners slightly rounded. Genital apertures marginal, opening about the middle line.

The compound hooks of the head have three recurved prongs each, the middle one slightly longer than the others, the inner one the shortest. These prongs rise from a common horizontal part, which is itself supported by a flattened or spatulate process, which lies immediately under the middle prong, is about the same length and parallel with it.

The following measurements were made from a mounted specimen:

	Millimeters.
Length of strobile	40.00
Length of head	0.52
Breadth of head	0.44
Breadth of neck	0.12
Length of first segments, 2mm from head	0.03
Breadth of first segments	0.01
Length of segments, 3mm from head	0.20
Breadth of segments, 3mm from head	0.42
Length of segment, 6mm from head	0.34
Breadth of segments, 6mm from head	0.42
Length of posterior segments	2.20
Breadth of posterior segments	0.84
Length of hooks	0.10
Length of bristly spines on neck or body	0.01

A few specimens in the lot differed from the prevailing type in being much more irregular in outline and having in general a more fragile structure. The neck is much distorted by contraction and much broader than in the prevailing type; the first segments, on the contrary, are longer and more slender. The posterior segments are elliptical, oblong, flatter, and more fragile in appearance.

In one specimen I found what seemed to be a transverse costa on the face of a bothrium. I looked in vain for a similar characteristic in the other specimens of the lot. If such costæ could be proved to be characteristic of this worm it would indicate a very close relationship with *Calliobothrium*.

In some the bristly spines were found on the neck and not on the body, in others sparsely on the body and not on the neck, in others thickly on both neck and body. They are, without doubt, the remnant of a bristly outer covering of the body, which is characteristic of the young and larval conditions of this genus.

The genus *Cylindrophorus* is a provisional one made by Diesing to include a single species which is not well known. He, however, includes it among those *Tetrabothriæ*, which are characterized by having no auxiliary acetabula on the bothria. The presence of a well-defined auxiliary

acetabulum in this worm is therefore sufficient reason for not including it in the genus *Cylindrophorus*. The almost invariable occurrence of spines on the neck or body, or both, together with the shape of the bothria and hooks, present so many points of resemblance to Wagener's figures, from which Diesing created the generic name *Cylindrophorus*, that I do not feel justified in adding a new generic term to the already burdened nomenclature of Helminthology without at the same time admitting Diesing's *Cylindrophorus* in the probable synonymy of the genus.

The ovaries occupy nearly the posterior fourth of the proglottis. The vagina extends, from its origin in the ovaries, as a sinuous duct along the median line of the proglottis until it reaches the middle point, where it turns nearly at right angles and opens in front of and immediately adjoining the penis. The latter organ is retracted and lies coiled up in the angle of the vagina, but seems to be connected with a convoluted mass, which is situated centrally in the proglottis. A median tube can be traced from near the anterior end of the proglottis to the angle of the vagina and seems to lie parallel with that duct for some distance. Its union with the latter could not be made out. The greater part of the interior of the proglottis is filled with irregular granular masses, each of which is composed of several irregular or disk-shaped pieces, which are rather loosely joined together.

In a specimen which had been subjected to double staining in green and red analine colors, the ovaries in the base of the proglottis and what appeared to be their continuation into a double row of coarse granular masses lying along each margin, had a strong affinity for the blue staining. On the margins, outside of the coarse granular layer, a fine granular layer, and outside of that a transparent, structureless, epidermal layer, were differentiated. The vagina and anterio-median tube were also slightly stained with the green. The interior compound granular masses, the penis, and the convoluted mass of tubes (vas deferens) were unaffected by the green coloring matter. They were clearly differentiated, though not deeply stained, by the red analine, nearly all the red stain having disappeared when the specimen was washed in alcohol.

Habitat.—Dusky Shark (*Carcharias obscurus*), in spiral intestine. August, 1884, Wood's Holl, Mass.

Calliobothrium Van Beneden.

Calliobothrium verticillatum Rudolphi.

[Plate IV, Figs. 1–8.]

Onchobothrium verticillatum Rud., Diesing, Syst. Helm., i, 606.

Calliobothrium verticillatum Van Beneden, Dies., Revis. d. Ceph. Ab. Par., p. 280–281. Van Beneden, in Mem. Acad. Belgique, xxv, 138 and 192, tab. xii.

Bothriocephalus verticillatus Rud., Synops., 142 and 484. Leuckart, Zool. Bruchst., i, 56, tab. ii, 41, fragm. Nitzsch., Ersch., and Grub., Encycl., xii, 99. Dujardin, Hist. Nat. des Helminth., 621. Creplin, Troschel's Arch., 1849, i, 73.

Acanthobothrium verticillatum Van Beneden, Bullet. Acad. Belgique, xvi, ii, 79.
Onchobothrium (*Calliobothrium*) *verticillatum* Diesing, Sitzungsb. der Kais. Akad., xiii (1854), 585. Molin, l. c., xxx (1858), 135, xxxiii (1858), 292, and xxxviii (1859), 10; Idem, Denkschr., xix, 239, tab. v, 3.
Tetrabothrium verticillatum Wagener, Nov. Act. Nat. Cur., xxiv, Suppl. 85, tab. xxii, 274 and 275.

Head continuous, with the subquadrangular body. Bothria four, angular, subelliptical, unequally divided into three loculi by two transverse ribs; each bothrium armed with four simple hooks, and provided, in front of hooks, with a trilocular, auxiliary acetabulum, the loculi of the latter arranged in a triangle. Hooks equal and arranged in pairs. Body filiform anteriorly, increasing posteriorly; anterior segments provided with four triangular, laciniate processes on the postero-lateral margin, followed by other segments bearing one, and still others bearing two, additional flaps on each postero-lateral margin, subsequent segments with two rounded flaps near posterior, nearly circular in outline; ultimate segments considerably elongated. Genital apertures marginal. Length 75^{mm} to 100^{mm}.

Habitat.—Found at Wood's Holl, Mass., August, 1884, in spiral intestine of Smooth Dogfish (*Mustelus canis*).

In this species there is so much difference between segments occurring in different parts of the strobile, that some additional notes are necessary in order to make trustworthy identifications in cases where only fragments are found. The head is so small that it may be easily overlooked by the collector; moreover the anterior segments are so delicate that, as is often the case, they break and leave the head imbedded in the mucous membrane of the intestines of their host. The anterior portion of a living specimen, when isolated from its natural surroundings and placed in clear water, resembles a very delicate white hair. It may therefore easily escape any but the most careful search. The head itself is only about one-eighth as broad as the head of a common pin, while the breadth of the segments immediately behind the head is about the same as that of a human hair, and the thickness is only about one-third the breadth. The first segments are nearly twice as long as broad, flat and thin, somewhat distinctly four-angled, so that a cross-section is rectangular. The segments are continued at the postero-lateral corners into four triangular flaps, which are about one-fourth the length of the segment proper. The posterior margins of the segments, including the flaps, are thick, white, and opaque in life, while the bodies of the segments are translucent.

A few segments back from the head the middle of the postero-lateral margin of the segment begins to rise, and soon assumes the form of a third flap. In one specimen, which measured 68^{mm} in length, this third flap begins about the 38th segment. This character continues for several joints until about the 70th segment, when the median flap becomes bifid; at the 80th segment it has become decidedly two-notched, and at the 120th it is divided into two lobes, so that in this part of the body

the postero-lateral edges of the segments are each distinctly four-lobed. The two original flaps, those near the margins, continue, however, to be a little longer and sharper-pointed than the two median ones. At the 150th segment the two middle flaps or lobes become indistinct, and are represented only by gentle flexures of the posterior margin; the notch between them is at this point broad and shallow. From the 160th or 164th to the 192d segment the median notch deepens gradually, and the secondary or median lobes disappear, leaving the postero-lateral margin two-lobed, the inner margin of each lobe with a slightly waving convex outline. The segments thus far are short and somewhat crowded, the length, in the specimen measured, after mounting in Canada balsam, uniformly about 0.14^{mm} to 0.16^{mm}. At the point where the segments become two-lobed the margins become rounded, convex, the segments lengthen to about 0.20^{mm}. At the 200th segment the proglottides are nearly circular in outline, globose in living specimens. At this point the segments begin to lengthen abruptly. The average length of the last four segments, with circular outline, being 0.64^{mm}, while the average length of the next four segments is 1.02^{mm}. The last segment the 212th in the specimen from which the above measurements were taken, measured 1.90^{mm} in length and 0.84^{mm} in breadth.

The following measurements are intended to show the proportions at different points on the strobile. They were made from mounted specimens, and consequently may be a little less than they would be if taken from living specimens:

	Milimeters.
Length of specimen	60.00
Breadth of head, in front	0.23
Length of bothria	0.30
Breadth of bothria, front and middle	0.10
Breadth of bothria, posterior end	0.04
Spread of hooks, tip to tip	0.16
Length of hooks	0.14
Breadth of segments just back of head	0.076
Breadth of segments 1^{mm} back of head	0.09
Length of segments without flaps	0.127
Length of segments including flaps	0.159
Breadth of segments 2^{mm} back of head	0.16
Thickness	0.02
Length	0.14
Length, including flaps	0.16
Breadth of segments 11^{mm} back of head	0.30
Thickness	0.08
Thickness, including flaps	0.16
Breadth of segments 18^{mm} back of head, four lobes	0.46
Length	0.16
Thickness	0.10
Breadth of segments 22^{mm} back of head	0.52
Breadth of segments 37^{mm} back of head, two lobes	0.66
Length, including flaps	0.16
Breadth of segments 45^{mm} back of head, round segments	0.78

	Millimeters.
Length	0.74
Length of posterior segments	1.90
Breadth of posterior segments	0.84
In another specimen:	
Length of posterior segments	2.20
Breadth of posterior segments	0.78

Number of joints in one specimen about 342, the last 11 of which were mature.

There was one prominent, transverse rib at about the posterior third of each bothrium; another, much less prominent, about the middle, at the extremities of the inner pair of recurved hooks, and two other faint, transverse lines, parallel with the ribs and apparently homologous with them, between this and the base of the hooks. The triloculars auxiliary acetabula showed but faintly in most of the specimens.

There is considerable difference between the anterior segments of the specimens examined and those figured by Van Beneden (Vers Cestoïdes, tab. xii). In Van Beneden's figures the anterior segments are represented as being several times as long as broad, and with the flaps rudimentary and rounded. The sketches of the head and anterior segments (Figs. 1, 2) were made from a mounted specimen. The proportions are identical with those of the living specimens, as is proved by comparing these sketches with some memorandum sketches made at the time of collecting. Among all the specimens, eight or ten in all, not one was noticed in which the segments differed materially from those represented in the figures. In Wagener's figures (Entwick. d. Cestoden, tab. xxii, fig. 274) the proportions of the anterior segments are about the same as I have found them. The transverse costæ of the bothria do not agree exactly with the figures of Van Beneden and Wagener, but the differences are so slight, that I have no hesitation in pronouncing the specimens which I have examined identical with those figured by Van Beneden and Wagener.

Family DIBOTHRIORHYNCHIDÆ *Diesing.*

Rhynchobothrium Rudolphi.

Taniæ spec. Fabricius.
Bothriocephali (*Rhynchobothrii*) and *Tetrarhynchi* spec. Rudolphi.
Bothriorhynchus Van Lidth.

Rhynchobothrium bisulcatum, sp. nov.

[Plate IV, Figs. 9–23.]

Head subconical, bluntly rounded in front. Bothria two, lateral, separating slightly at posterior corners, coalescing in front, each divided into two distinct lobes by a median sulcus, which extends from the posterior border about one-fourth the length of the bothrium, where it divides into two less distinct but clearly marked sulci, which diverge

and inclose two sides of a triangular space. At the extreme anterior end of each of these secondary sulci is situated one of the four proboscides. Each bothrium is broadly convex on the posterior border, with often a slight emargination on the posterior edge of each lobe. Each lobe is triangular, the posterior side being the posterior edge of the bothrium, the outer side being the marginal edge of the bothrium, and the inner side being bounded by the median sulcus and one of its branches. The central portion or face of each lobe is sometimes depressed, which gives rise to the appearance of a double furrow on each side of the median triangular piece. Posterior edges of bothria thick and fleshy, overlapping the neck. Neck tubular, conical, sometimes slightly swollen back of the head, a little shorter than the bothria, the posterior fourth prolonged into a collar, which incloses the anterior part of the body and its articulation with the neck. Proboscides (*trypanorynchi* Dies.) four, a little shorter than head, armed with numerous hooks arranged in spirals, about eight visible in each spiral; spirals about 0.02^{mm} apart. Hooks recurved, pointed, broad at base in an antero-posterior direction, very thin from side to side, those near the base of the proboscis shorter-curved and blunter than the others. Proboscis sheaths straight in front, but with a single short spiral curve at the posterior end where they join the contractile bulbs, with one of which each is connected. The four contractile bulbs, which lie side by side in the neck, are about twice as long as broad and about one-half the length of the neck. The distance between the point of articulation between the neck and the body and the posterior end of the contractile bulbs is normally about one-third the length of the latter.

So far as examined the heads presented the same general outline, with one exception. In the exceptional case noted there is a slight constriction of the bothria where they overlap the neck, at the point which marks the greatest diameter of the head in all the other specimens. This imparts to the head a more rounded outline in front than in the others, and a less diameter proportionally at the base of the bothria.

The body, usually very much attenuated anteriorly, is unjointed for a short distance back of the head. Fine transverse lines soon make their appearance, and shortly afterwards the first segments are formed. The latter are usually much broader than long, and rectangular in outline. Although they sometimes are lengthened with rounded corners, so as to give to the series of segments a beaded appearance.

The mature proglottides are always squarish, or rectangular, sometimes longer than broad, sometimes broader than long. The male genital openings are marginal, irregularly alternate, always near the anterior edge of the proglottis. Female genital openings lateral, median dehiscent, apparently not appearing until the proglottides are almost ready to separate.

Length of strobiles with mature proglottides from 40^{mm} to 230^{mm}.

The following measurements of head and neck give proportions which hold good for all:

Dimensions.	Marginal view.	Lateral view.
	mm.	*mm.*
Length of head	0.90	1.04
Breadth of head	1.10	1.04
Length of neck	0.76	0.70
Breadth of neck, anterior	0.72	0.76
Breadth of neck, posterior	0.40	0.44
Breadth of strobile back of neck	0.28	0.28

	Millimeters.
Length of proboscis	0.840
Breadth of proboscis, exclusive of projecting hooks	0.043
Breadth of proboscis, inclusive of projecting hooks	0.078
Length of anterior hooks	0.023
Breadth of base of anterior hooks	0.013
Length of hooks on base of proboscis	0.014
Breadth of base of hooks on base of proboscis	0.011

In the summer of 1884 I obtained two lots of these worms from the alimentary tract of the Dusky Shark (*Carcharias obscurus*).

The first lot, containing approximately 200 individuals, was lodged in the pyloric portion of the stomach, where the worms were so massed together as to make a swelling in the pylorus which was discernible before opening.

These specimens were not studied closely while they were alive. Upon examining them subsequently as alcoholic specimens, it was found that there was a very considerable variation in the length of the strobiles, and to some extent in the proportions of the segments. In the foregoing description I have enumerated those characters which belong to all; but inasmuch as there are some more or less clearly marked groups among them I shall add some further observations. I deem this of importance, for the reason that, if it were not for the great number of intermediate forms which these two lots furnish, one might be justified in making two, if not three, distinct species instead of one. The second lot came from the pylorus and spiral intestine of the same species of shark (*C. obscurus*).

Three groups were observed in the first lot. These differ from each other principally in the shape and proportions of the segments, the distance from the head at which mature proglottides occur, and in the total length of the strobile.

In the first group, which, for the sake of clearness, I shall name var. *a* (Plate IV, Figs. 9–12), the mature proglottides are flat and thin, square, or the posterior ones a little broader than long. When there are but few mature proglottides they increase in breadth rather abruptly, so that the strobile has a somewhat club-shaped or linear-obovate outline.

Generative organs: male not conspicuous, smooth, marginal, near anterior edge of proglottis as in all; female lateral, median, dehiscent, in mature proglottides easily recognized as a clear central spot; length of strobile as short as 36mm; average, perhaps, about 45mm, although it seems to graduate into var. β, which is much longer. In one specimen measuring 48mm, the last twelve proglottides were mature and had an average length of 1mm.

Measurements of a specimen, var. α, made from a mounted specimen, and hence probably a little distorted:

	Millimeters.
Length of strobile	36.00
Length of bothria	0.80
Breadth of head	0.90
Length of neck	0.70
Breadth of neck in front	0.60
Breadth of neck, posterior end	0.36
Length of proboscis	0.70
Length of proboscis sheath	0.76
Length of contractile bulb	0.32
Breadth of contractile bulb	0.14
Length of posterior proglottis	0.80
Breadth of posterior proglottis	1.30

The second group I shall also, for convenience, designate as a variety, calling it var. β (Plate IV, Figs. 17–20). The strobile, like that of var. α, is flat and thin, but is much longer. The mature proglottides do not make their appearance until 100mm, or even 200mm, back of the head. The first segments are short and broad; the succeeding segments increase in length until they become longer than broad. The median and postero-median segments are frequently rounded at the corners, giving to the strobile a beaded appearance. This character is usually present in those segments which immediately precede the mature proglottides. Usually about three longitudinal striæ can be traced on the median segments (Figs. 18–19). The posterior segments are rectangular, longer than broad. The following measurements were made on a mounted specimen, var. β.

	Millimeters.
Length of strobile	230.00
Length of head	0.76
Breadth of head	0.94
Length of neck	0.70
Breadth of neck in front	0.70
Breadth of neck, posterior end	0.40
Length of proboscis	0.60
Length of proboscis sheath	0.64
Length of contractile bulb	0.36
Breadth of contractile bulb	0.16
Breadth of strobile back of neck	0.26
Length of posterior proglottis	1.54
Breadth of posterior proglottis	1.20

A third group, which comprises individuals that have certain characteristics separating them from the two preceding groups, I have distin-

guished as var. γ (Plate IV, Figs. 13–16). These are all immature strobiles, but are much longer than var. α, and in some cases as long as var. β. The strobile is much thicker and rather wider than those of varieties α and β. The posterior segments, although not mature in any of the specimens, have a conspicuous male generative organ. The female generative opening is represented by a lateral, median, slightly raised papilliform eminence. Length about 100^{mm}; average length of last 30 segments 0.6^{mm}. The posterior segments are 2½ to 3 times as broad as long.

Measurements made from two mounted specimens.

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length of strobile	92.00	82.00
Length of head	1.10	0.70
Breadth of head	1.18	0.86
Length of neck*	1.00	0.60
Breadth of neck in front	0.80	0.54
Breadth of neck, posterior end	0.44	0.40
Length of proboscis	0.70	0.70
Length of proboscis sheath	0.90	0.70
Length of contractile bulb	0.46	0.36
Breadth of contractile bulb	0.16	0.10
Breadth of strobile back of neck	0.30	0.30
Length of posterior segment	0.50	0.40
Breadth of posterior segment	1.60	1.36

* In all measurements of the neck the distance from the postero-lateral or postero-marginal edge of the bothria to the posterior edge of the collar is the one given.

In the second lot containing about fifty specimens, the strobiles are not so mature as those of the first lot. The three varieties noted in the first lot are not so distinctly marked off. There are, however, two distinct kinds in this lot, which may possibly be due to the effect of the preservatives, but which are sufficiently noteworthy to be mentioned here. In the first the lobes of the bothria are smooth and bounded by regular curved lines as in the first lot, but with the centers of the faces of the lobes slightly hollowed out or depressed, so as to produce the effect of a raised border, and double furrows on the lateral face of the bothrium.

In the second the bothria are irregularly furrowed or wrinkled. The bothria are shorter than the neck. The neck is also wrinkled. These differences, although sufficiently marked to attract attention, do not occasion much perplexity where one remembers the wonderful powers of contractility possessed by the *Cestoidea*. They might, however, lead to confusion of species in cases where only a few specimens are at hand.

In describing new species of the *Cestoidea*, I am satisfied that, where it is possible, a great many specimens should be examined before final conclusions are reached. If this rule had been adopted by former workers in this field of Systematic Zoology the older literature of Helminthology would not be in its present state of confusion.

Attachment to the host.—Those found in the pylorus were not firmly attached, but would release their hold when the point of a scalpel was

applied to their heads. This was characteristic of those of the first lot. With those found in the spiral valve, however, the case was quite different. In it these parasites were found to be firmly attached to the wall of the intestine. Many of them had tunneled holes in the mucous and submucous coats. In some cases these tunnels cut through the muscular coats of the intestine and opened into the interior body cavity. In some instances several heads were found occupying the same cavity. One of these pockets was 6.5mm deep. In it were imbedded three heads belonging to three strobiles 20mm, 32mm, and 55mm long, respectively. The heads were so tightly fastened in their fleshy cavern that they had to be cut out before they could be removed. A peculiarity of the individuals of this second lot is a tendency to contract the anterior segments, so that instead of being attenuated as in most of those of the first lot, the anterior segments are at first nearly as broad as the neck, and immediately widen until they are as broad or even broader than the head. This gives the worm the appearance of being constricted just back of the head. This habit of tunneling into the flesh of its host must make this parasite a very unpleasant guest. Usually in the case of those *Cestoidea* which infest the alimentary canal of their host, their presence cannot give rise to much pain, unless they are present in numbers sufficient to occasion obstruction. But with this worm it is quite otherwise. Wherever tunnels in the walls of the intestine caused by this worm were observed, it was noticed that there was much irritation of the mucous membrane. Not only was the mucous coat highly inflamed, but the inflammation often extended into the submucous and muscular coats. The whole interior of the spiral valve was blotched with angry-looking sores. If this is at all common, then we find in this worm an enemy of the Dusky Shark, small but not insignificant. It is certainly encouraging to find in nature, in the too small army of enemies which are arrayed in warfare against the Selachians, these humble sappers and miners lending their aid towards keeping down the numbers of these Ishmaelites of the sea.

Abnormal forms.—In the second lot a few monstrosities were observed, two of which are figured (Plate IV, Figs. 21 and 22). The first example, Fig. 22, is a strobile 13mm in length, which, at about 2mm from the posterior end, gives off from the postero-marginal edge a secondary strobile, in which there are about four joints faintly marked. The dimensions of the segment which sends off this budding part are: Length, 0.1mm; breadth, 0.72mm; of the succeeding segment, length, 0.1mm; breadth, 0.62mm; of the budding portion, length, 1.08mm; breadth, 0.06mm. The second example, Fig. 21, is a fragment; length of strobile not known. The segments have the beginnings of the male genital organs. A secondary strobile is given off from the margin of the primary strobile in a somewhat different manner from the one just described. A tendency towards a marginal thickening can be seen on the third segment in front of the one from which the secondary strobile becomes free. In the succeeding segments this marginal thickening,

or rather widening, is more pronounced, and there is the beginning of an independent alar margin. On the next segment the alary margin is one-fourth the breadth of the segment itself, and from it springs the secondary series of segments. The breadth of the three segments mentioned is 0.82mm, 0.86mm, 0.90mm, respectively, or of the latter, exclusive of the alary margin, 0.72mm. The breadth of the succeeding segment is 0.72mm. The length of each of these segments is 0.26mm. Length of secondary strobile, 2.46mm; number of segments, 21; breadth, 0.20mm to 0.24mm; average length, 0.12mm.

Eversion and inversion of proboscis.—The proboscides do not play backwards and forwards in their sheaths like a piston-rod in its barrel, but each folds in upon itself from the outer extremity like the finger of a glove. When a proboscis is fully extended it has the appearance of a slender, solid cylinder, covered with recurved hooks. If, however, one which is not fully extended be examined, it will be found to be folded in upon itself from the outer end. As the hooks point backwards when the proboscis is extended, it can be easily seen that it is impossible to retract that organ by pulling it in bodily. When the proboscis is entirely retracted it forms a hollow tube, whose outer covering is the inside wall of the extended proboscis, and whose inner coat carries the hooks which now point forward. The whole tube lies in the proboscis sheath.

The manner of everting and inverting the proboscis seems to be identical in all the *Trypanorhynchi*, both in the mature and later larval stages. The contractile bulbs and proboscis sheaths contain a transparent liquid, in which float a few granules. The contractile bulbs act on the contained fluid exactly as the bulb of a syringe. The thick walls of the bulbs are composed of diagonal, interlacing fibers, whose contraction compresses the bulb and forces the fluid out into the proboscis sheath. The result of this action is to make the proboscis begin to unroll from the anterior end of the sheath. This will continue as long as the walls of the contractile bulbs continue to exert pressure on the fluid contents, or until the proboscis is entirely everted. When the proboscis is fully extended the granular liquid can be seen filling the interior of both proboscis sheath and proboscis. To the interior of the proboscis, at the anterior end, is attached a tubular cord of very contractile tissue, which lies in the hollow of the proboscis, extends back through the sheath, and is inserted at one side on the inner wall of the contractile bulb. The proboscis is inverted by the contraction of this cord. When the proboscis is inverted this cord lies in kinks and irregular coils in the contractile bulb and posterior end of the sheath. This movement is made rather quickly by the living worm. Upon removing some specimens from the pylorus of a Dusky Shark, it was noticed that when the heads were touched by the point of a scalpel or needle, even when the head was partly imbedded in the mucous membrane, the proboscides would be suddenly retracted and the worm detached.

Larval state.—Great numbers of encysted *Rhynchobothria* were found, mostly in capsules, between the mucous and submucous coats of the stomach of the Squeteague (*Cynoscion regale*) and the Bluefish (*Pomatomus saltatrix*), which appear to be the young form of this species. The proboscides and their hooks agree. The bothria and their lobes seem to be identical. The sequence from these fishes to the Dusky Shark is a natural one, and in the absence of any evidence to the contrary it may be fairly assumed that they are the encysted larvæ of *R. bisulcatum*. It is the purpose of the author to publish figures and a fuller description of these in a subsequent paper.

Habitat.—Strobile: Dusky Shark (*Carcharias obscurus*); pylorus and intestine; very abundant.

Scolex encysted: Squeteague (*Cynoscion regale*), Bluefish (*Pomatomus saltatrix*); submucous coat of stomach and peritoneum; very abundant. Wood's Holl, Mass., August.

This worm resembles *R. paleaceum* Rudolphi and Van Beneden. (Dies., Revis. d. Ceph. Ab. Par., p. 294.)

Tetrarhynchus lingualis Van Beneden (Les Vers Cestoides, p. 151, tab. xvii, 4, 6–9). It presents many differences from Van Beneden's figures and descriptions, however, among which may be mentioned here, as of most importance, the number and form of the hooks, the articulation of the neck with the body, and the position of the male genital openings. Van Beneden represents the latter in *R. paleaceum* as always opening at the posterior third of the segments. In all of the different forms of *R. bisulcatum* they open uniformly near or in front of the anterior third.

Rhynchobothrium tenuicolle Rudolphi.

[Plate V, Figs. 17, 18.]

Tetrarhynchus tennicollis Rud., Synops., 130 and 451. Creplin, Ersch. and Grub. Encycl., xxxii, 295, note 34, and Erichson's Arch., 1846, 149. Dujardin, Hist. Nat. des Helminth., 551.

Rhynchobothrium tenuicolle Diesing, Sitzungsb., xiii, 1854, 595; and Revis. der Ceph. Ab. Par., 299.

Tetrarhynchus corollatus Siebold, Zeitsch. für Wissensch. Zoöl., ii, 241 (in part).

The characters given for this species by Diesing are the following: Head with suborbiculate lateral bothria, converging at the apex and with an elevated border; neck very long, subcylindrical, slender, rounded at the base; segments of the body bacilliform, ultimate ones contracted, easily falling off. Length of head and neck, 5.3^{mm} to 6.5^{mm}; length of body, 15^{mm} to 17^{mm}; breadth, 0.56^{mm}.

The proboscides for the larval condition are described as filiform, very slender, and armed with a long series of ternately verticillate and recurved hooks.

The published descriptions of this species are meager and unaccompanied with figures. It is with some hesitation, therefore, that I refer a few *Rhynchobothria* from the spiral valve of the Smooth Dogfish (*Mustelus canis*) to this species.

The head of the living worm is very variable in shape. The bothria are lateral and are united at the apex by their margins; usually broader than long, slightly emarginate on the posterior edge, with a raised and thickened border. The neck is long, cylindrical, the narrowest part about half way between the head and the contractile bulbs. There is a constriction immediately behind the contractile bulbs, back of which the neck swells into a nearly globular base. This rounded basal part of the neck is sharply marked off from the body by a short, narrow constriction. The body is without segments or transverse markings of any kind for a distance equal to as much as six times the length of the head and neck. Striæ then begin, which outline squarish segments. The first segments are a little longer than broad; subsequently they become much longer than broad, crowded with ova, and with the genital apertures marginal. The four proboscis sheaths are long and thrown into spirals, the coils of the spirals being dense or loose, as the neck is contracted or not. The proboscides when everted are seen to be very long and slender. They are closely beset with small hooks, which, when highly magnified, are seen to be of several distinct shapes. The prevailing shape of those near the end of the proboscis is slender, tapering, somewhat irregular in outline, with an abruptly recurved short point. Others have the same length, but differ in being broader, and in having a curved, convex outline on the posterior edge. Others have the same outline, but are very short. Others are slender, curved slightly and pointed, but are without the abruptly recurved point. Some are straight, others nearly straight, but bent slightly about the middle. The hooks on the proboscides, moreover, are arranged in distinct series of ternate groups. This arrangement could be plainly distinguished in some places, while in others it was but faintly indicated, and, owing to the extreme smallness of the hooks and their peculiar shape, it was impossible, from the specimens at my disposal, to determine the exact number of series, or whether, indeed, all the hooks were arranged in these ternate groups or not. Where most distinct there seem to be four series of ternate hooks. The longer hooks stand nearly at right angles to the axis of the proboscis, and are equal in length to about one-third of the diameter of the proboscis.

The following measurements are from an alcoholic specimen:

	Millimeters.
Length of strobile	31.00
Length of bothria	0.42
Breadth of bothria	0.34
Length of head and neck	2.00
Length of proboscis sheath	1.40
Length of contractile bulbs	0.29
Breadth of contractile bulbs	0.10
Breadth of neck near head (lateral)	0.24
Breadth of neck near middle (lateral)	0.20
Breadth of neck in front of basal bulb	0.34

	Millimeters.
Breadth of basal bulb of neck	0.39
Breadth of constriction between neck and body	0.20
Breadth of body just behind basal bulb of neck	0.28
Breadth of body 7.4mm from neck	0.28
Distance from neck to first striæ	11.20
Distance from neck to first segment	14.60
Length of first segments indicated by striæ	0.40
Breadth of first segments indicated by striæ	0.44
Length of first distinct segments	0.94
Breadth of first distinct segments	0.44
Length of last segments	3.00
Breadth of last segments	0.80
Breadth of proboscis	0.33
Length of hooks	0.0075
Length of longest hooks	0.009

These worms are actively locomotile while living. The two bothria act as sucking disks and change their shape continuously. As the head progresses the anterior ends of the proboscis sheaths separate slightly, when the soft tissue which forms the anterior end of the head is then drawn in so as to give to the front of the head the shape of a hollow cup; the anterior ends of the sheaths then approach each other and the hollow cup disappears, the tissue which forms it being thrust out into a short, blunt eminence (myzorhynchus).

Habitat.—Smooth Dogfish (*Mustelus canis*), in spiral intestine. Wood's Holl, Mass., August, 1884.

Family TETRACOTYLEÆ *Diesing.*

TÆNIA Linn.

Tænia dilatata, sp. nov.

[Plate V, Figs. 14–16.]

Head small, truncate, or, in living specimens, slightly prominent in front. Acetabula nearly circular, directed a little forwards. Neck rugose, very long, very contractile and dilatable, narrow in front, tapering toward the head; a short distance back of the head expanding into a number of irregular, transparent, dilated folds, which border both sides of an opaque central portion, in which two longitudinal canals are faintly outlined. First segments about three times as broad as long; median segments square, or broader than long; ultimate segments nearly square, sometimes broader than long, sometimes longer than broad. Genital apertures marginal, opening a very little in front of the middle.

A single specimen of this species of *Tænia* was obtained from the intestine of the Common Eel (*Anguilla vulgaris*) August 26, 1885. The

length of the specimen, when stretched out by fastening one end with a needle to the bottom of the dissecting dish and removing all kinks and curves with a fine brush, was 170mm. The length of the same specimen, after having been preserved in alcohol, is less than 90mm. The specimen when first obtained and placed in sea-water was quite active. The body was constantly throwing itself into sinuous curves, while the head and neck were jerked from side to side with a moderately rapid motion. In addition to these movements the neck and anterior portions of the body constantly changed their shape by the inflation or dilatation of the investing membranes into wide transparent folds, constricted at irregular intervals by narrow transverse bands. The neck, meanwhile, was alternately stretched out and contracted like the body of a Nemertean. The anterior end of the head protruded into a proboscis-like papilla. The breadth of the head itself varied from 0.17mm to 0.35mm.

In the alcoholic specimen the dilatable folds of the neck are much contracted and broken. They lie in rough, ragged frills along each side of the dark central part of the strobile. The head is truncate or blunt in front. The neck immediately behind the sucking-disks is almost as wide as the head, flat, thin, and little, if at all, tapering.

The following measurements were made on the living specimen. The head and neck changed their position and shape so rapidly that it was with the greatest difficulty that trustworthy measurements could be made:

	Millimeters.
Breadth of head	0.28
Diameter of acetabula	0.12
Diameter of neck, narrowest part	0.20
Distance of first segments from head	17.00
Length of fourth segment from end of strobile	1.30
Breadth of same, posterior end	1.50
Breadth of same, anterior end	1.60
Length of posterior segment	0.90
Breadth of same, posterior end	0.60
Breadth of same, anterior end	1.25

Habitat.—Common Eel (*Anguilla vulgaris*); intestine; Wood's Holl, Mass., August 26, 1885; one specimen.

Von Linstow (Compend. der Helminth., 1878) records but two *Tæniæ* from the Common Eel, *T. macrocephala* Creplin and *T. hemispherica* Molin. *T. dilatata* is very different from the former. Diesing (Revis. der Ceph., Ab. Cycl., p. 378) mentions the latter, but gives no enumeration of characters. I do not have access to Molin's paper, and cannot, therefore, say whether *T. dilatata* is identical with his species or not. The peculiar inflated character of the neck suggests *T. ambigua* Dujardin, but the difference in size between the adult specimens is alone sufficient to render their union in the same species impossible.

Order ACANTHOCEPHALA Rudolphi.

Echinorhynchus Zoega.

Echinorhynchus agilis Rudolphi.

[Plate V, Figs. 1-6.]

E. agilis Rudolphi, Synopsis, 67 and 316. Westrumb, Acanthoceph., 17, tab. i, 1. Bremser, Icon. Helminth., tab. vi, 9-10. Dujardin, Hist. Nat. des Helminth., 535. Diesing, Syst. Helminth., ii, 35, and Revis. der Rhyngod., 746. Molin, in Sitzungsb. d. Kais. Akad. d. Wissensch., xxx, 142.

Color white. Proboscis clavate, very short, nearly globose, armed with three, sometimes apparently only two, series of hooks, about six in each series. Hooks in front row three or four times as long as those in second and third rows, each with a long, flat basal support. Front hooks sharply recurved, with recurved part long, pointed, and often slightly concave on the outer edge. Remaining hooks very small, slender, slightly bent, sometimes standing out nearly at right angles to the axis of the proboscis, when the latter is exserted. Anterior part of the body slightly contracted and capable of introversion along with the proboscis, thus forming a short, transversely plicate neck. Body arcuate, club-shaped, cylindrical, transversely rugose, widest a little in front of the anterior third, narrowing rapidly in front and diminishing uniformly but very gradually to the posterior end, which is truncate. Proboscis sheath rather short, manubriform; proboscis and sheath often found retracted by an invagination of the anterior body wall. Lemnisci usually long, slender, attenuate posteriorly, longer proportionally in male than in female. Testes three-lobed, followed by an oval opaque mass. Male genitalia posteriorly continued into a cup-shaped copulatory organ, which is capable of eversion and inversion.

Females 9^{cm} to 12^{mm} in length; males 4.6^{mm} to 6.44^{mm}.

When subjected to the action of the compressor a series of oval and circular cavities becomes visible in the inner coat of the body wall. These are evidently the channels of the vascular system seen in section. At intervals, however, there are large circular spaces in this vascular layer clearly defined by a circular thickened ring of connective tissue. These become so much enlarged in some as to be visible with a comparatively low magnifying power, and give rise to small mammillary elevations in the superficial layer of the body wall. These are evidently the "pores" or "orbicular disks" given as specific characters of *E. tuberosus* (Dujardin, Nat. Hist. Helminth., p. 538). They are described as usually numbering five or six on the convex side and a single one on the concave side. In the specimens which I have examined there does not appear to be either this regularity or proportion in their arrangement, *e. g.*, one specimen had four on the concave side and two on the

convex. In others they could not all be made out definitely, but enough could be made out to show that they were irregularly placed.

Habitat.—Common Eel (*Anguilla vulgaris*); intestine; 12 specimens, ♂ and ♀; September 2, 1885. Dusky Shark (*Carcharias obscurus*); 1 specimen, ♂; August, 1884. Wood's Holl, Mass.

Of the following specimens of which measurements were made, No. 1 is a female, Nos. 2 and 3 are males. No. 3 is the specimen obtained from the spiral intestine of *C. obscurus*:

Dimensions.	No. 1, ♀	No. 2, ♂.	No. 3, ♂
	mm.	*mm.*	*mm.*
Length of specimen	9.50	6.44	4.60
Length of proboscis	0.17	0.105	0.16
Breadth of proboscis, apex	0.17	0.14	0.162
Breadth of proboscis, base	0.15	0.12	0.132
Length of proboscis sheath	0.46	.....	0.30
Breadth of proboscis sheath	.....	.....	0.12
Length of lemnisci	1.50	1.50	1.40
Breadth of body, anterior	.....	.....	0.19
Breadth of body, greatest	.....	.....	0.50
Breadth of body, posterior end	.....	.....	0.16

	Millimeters.
Length of hooks in front row	0.084 0.090
Length of hooks in second row	0.023
Length of recurved part of front hooks	0.061
Length of ova	0.035
Breadth of ova	0.017

Length of ovarian masses much greater than ova, circular and oval, with diameters as much as 0.1mm, others as low as 0.04mm.

I confess no small degree of perplexity in identifying this species as *E. agilis*. The arrangement and character of the hooks of the proboscis ally it closely with this species and a little less closely with *E. claviceps* Zeder. The lemnisci are not so long in proportion to the length of the animal as in either of the above-named species. This is about the only character that hints at a probable specific difference which is sufficient to justify the separation of the specimens under consideration from either of the above species. The presence or absence of the so-called neck is rather a doubtful feature at best.

While there are no distinctive characters which seem to my mind to be important enough to justify the erection of a new species, there are certainly strong reasons afforded for uniting *E. claviceps* and *E. tuberosus*, which is, indeed, proposed by Dujardin (op. cit., p. 538) and accepted by Diesing, who does not mention *E. claviceps* in his revision, and including both under *E. agilis* Rudolphi.

In the absence of figures of these species I must content myself at present with referring these specimens to *E. agilis*.

With regard to the single specimen found in the spiral valve of *Carcharias obscurus*, it may be well to observe that its presence there may be accounted for by supposing it to have been introduced in the adult

condition along with some more usual host which had been eaten by the shark a short time before the latter was examined. However interesting this supposition may be, it is hardly necessary, as there is no reason why *C. obscurus* should not be a proper host of *E. agilis*.

Echinorhynchus acus Rudolphi.

[Plate V, Figs. 7–13.]

Rudolphi, Wiedmann's Archiv., ii, 2, 51; Entoz. Hist., ii, 279; Synops., 71 and 324. Zeder, Naturg., 150. Westrumb, Acanthoceph., 24. Siebold, in Burdach's Physiol., 2, Anfl., ii, 196 (ovulæ). Drummond, Charlsworth's Mag. of Nat. Hist., ii, 516. Bellingham, in Annals of Nat. Hist., xiii, 256. Dujardin, Hist. Nat. des Helminth., 540. Creplin, Nov. Obs., 43, and in Ersch. and Grub. Encyclop., xxxii, 284. Leidy, in Proceed. Acad. Phila., viii, 48. Van Beneden, Mem. Vers. Intest., 279–287 (development).

For detailed synonymy and habitats, see Diesing, Syst. Helm., ii, 39–40, and Revis. d. Rhyngodeen, 747.

Proboscis linear with about twenty series of hooks; neck none; body long, greatest width a short distance back of proboscis, subattenuate posteriorly, bluntly rounded at posterior end. Length 27 to 81mm (Dujardin), breadth 2mm; males half as long as females; color usually white.

"The color is very various but generally white when distended, though frequently accompanied at the same time by a tinge of orange, pink, or cinereous. Sometimes the whole animal is reddish orange (especially the male), and sometimes the whole is ivory white with a solitary minute crimson dot here and there" (Drummond).

Some specimens flat, thin, with regular outline, others cylindrical with irregular transverse rugæ. All the specimens noted by me were white or faintly tinged with yellow.

The following measurements were made on alcoholic specimens:

Dimensions.	No. 1, ♀	No. 2, ♀	No. 3, ♂
	mm.	*mm.*	*mm.*
Length of specimen	46.00	45.00	20.00
Length of proboscis	1.04	1.06	0.96
Breadth of proboscis	0.28	0.32	0.28
Length of proboscis sheath	1.44	1.60	1.40
Breadth of proboscis sheath	0.36	0.36	0.36
Breadth of body, anterior	0.75	0.80	0.60
Breadth of body, antero-median	2.00	1.60	1.20
Breadth of body, near posterior end	0.60	1.10	0.60

Length of longest living specimen, 60mm.

Dimensions.	Millimeters.	Millimeters.	Millimeters.
Longest diameter of ovarian masses	0.11	0.07	0.08
Shortest diameter of ovarian masses	0.075	0.05	0.07
Length of ova	0.13	0.114	0.112
Breadth of ova	0.03	0.055	0.023
Length of embryo	0.098	0.08	0.076
Breadth of embryo	0.017	0.018	0.015

Length of hooks, 0.064mm; breadth of same at base, 0.02mm.

The proboscis, when fully extended, stands a little obliquely to the axis of the body. In all the specimens that I have seen the proboscis was either wholly extended or partly withdrawn bodily. In no case was the proboscis inverted. These worms are able not only to withdraw and to protrude the proboscis as a whole, but also to invert and evert it. When the proboscis is retracted in mass the walls of the body at the base of the proboscis are invaginated by the action of retractor muscles, which are attached to the base of the sheath and inserted on the median parietes of the body. When thus retracted the proboscis lies as a rigid cylindrical rod inclosed in a pouch made by the invaginated anterior end of the body (Fig. 12).

The protrusion of the proboscis seems to be effected by the propulsive force exerted by the fluid contents of the body cavity when forced forward by muscular contraction of the body-wall. A retractor muscle, or ligament, was traced from the interior of the proboscis sheath to the apex of the proboscis. Inversion of the proboscis itself is effected by this ligament, while eversion is produced by the action of the thick, muscular walls of the sheath upon a granular fluid which it contains. The hooks of the proboscis are arranged in quincunx order, thus giving rise to rows parallel with the long axis of the proboscis, and also to spiral rows. The body cavities of the females were crowded with myriads of eggs. These were long-oval and each contained a fusiform embryo. The outer covering of the ova is a delicate but rather thick, transparent membrane. Within this and immediately surrounding the embryo is a thin but dense coat, which is much compressed at one end so as to look like a loop, slightly compressed at the other. The embryo in most of the ova had not developed sufficiently to indicate more than a fusiform, granular mass lying within the dense hyaline inner coat of the ovum.

The spherical ovarian masses were in different stages of progress, some having simple granular contents, others having secondary masses within them, while in others oblong bodies, apparently young embryos or the beginnings of ova, could be distinctly seen.

Habitat.—Flat Fish (*Pseudopleuronectes americanus*), in intestine; eight specimens. Wood's Holl, Mass., September, 1884.

Echinorhynchus sagittifer, sp. nov.

[Plate VI, Figs. 1–2.]

This worm was found in the peritoneum of several species of fish. Although no adult specimens were found, the form of the immature specimens is so different from that of any adult *Acanthocephala* with which I am acquainted, and the structure and arrangement of the spines are so remarkable, that I propose the name *E. sagittifer* for it. Of course it is possible that it may subsequently be identified as the young

of some form already described, as the spines of the body are probably shed in the course of its further development.

The proboscis is clavate, bluntly rounded in front, increasing slightly for a short distance back, and then narrowing gradually to the base, thickly beset with recurved hooks, of which there are about twenty series, counting from base to apex, and about fifteen visible in the longest spiral; proboscis eversible; neck short, unarmed; body always curved, anteriorly armed with sagittate spines, thus forming an armed collar back of the neck, the spines of which are arranged in about eight transverse rows, but placed a little irregularly. A short distance back of this spiny collar is a transverse row of sagittate spines, which are placed on the inner (ventral) part of the curve, and extend up each side nearly to the outer (dorsal) edge. Following this row are about twenty other rows of similar spines, similarly placed, except that none of them contains as many spines, and hence is not as long as the first row. The first eight or ten rows do not differ much in length nor in the number of spines; posteriorly the rows become shorter and shorter until the last, in which the spines are few and hard to distinguish. The body increases in size for some distance back of the neck, attains its greatest dimensions about the anterior third, and diminishes uniformly to the posterior end, which is in some slightly enlarged, ending ing with a bluntly rounded point.

These worms were all found in the body cavity of their host, coiled up and lodged in the serous coat of the intestine or stomach, or in the mesentery. When found they usually had the proboscis inverted, but everted it, in whole or in part, when immersed in alcohol or when placed under the compressor. They were surrounded by a thin investing membrane, which was of the nature of a cyst, while at the same time it appeared to belong to the worm. They were uniformly coiled in a curved or lunate shape, with the rows of spines on the concave side. The body is much roughened by transverse wrinkles or creases, especially towards the posterior end.

The branching vascular system characteristic of this order is clearly defined. If the plane in which the curved animal lies be called a dorso-ventral one, then the principal vessels of the vascular system are lateral.

The sexual characters were already plainly distinguishable. In one specimen two oval masses suspended from the base of the proboscis sheath were identified as the beginning testes. These were oval, granular bodies, the first 1.16 mm back of the proboscis sheath, and the second 0.34mm farther back; length of each 0.164mm; breadth 0.127mm. They lay in the ribbon-like band or tube which in all the specimens depended from the base of the sheath, and which doubtless represents the suspensory ligament. Behind the anterior oval body lay a cluster of spherical nucleated cells. The genitalia, in this specimen, ended in a campanulate expansion, at the base of which a small pointed body was

recognized, which was probably the spiculum. This enlargement of the genital apparatus opened into a larger oval cavity in the extreme posterior end of the body. This was evidently the male bursa, but was still closed by the investing body-membrane.

In some specimens which had been stained and mounted in glycerine, bodies which looked like the lemnisci were discovered. These were paired organs, very long and slender, tapering gradually to near the posterior end, which was bluntly rounded. Their attachment was at the base of the proboscis sheath. In one specimen the attachment was by a short ligament. The general appearance of these organs was much like that of the lemnisci of *E. agilis*, but their attachment at the base of the sheath, instead of near the base of the proboscis, makes their indentification as lemnisci doubtful.

In a series of thin longitudinal sections made from one of these worms a cluster of spherical, granular masses was found lying just back of the base of the proboscis sheath and apparently supported by the suspensory ligament. These masses were each about 0.025^{mm} in diameter, and each contained a number of smaller cells. It is probable that these represent the early stages of the ovarian masses peculiar to this order.

The proboscis sheath is thick-walled and made up of two layers, the outer dense, about 0.03^{mm} thick; the inner loose in texture and 0.032^{mm} thick. From the base to about the middle of the sheath these layers are close together; from that point to the base of the proboscis they separate slightly, but unite again at the base of the proboscis. A retractile ligament extends from the proboscis back through the neck, where it divides into two branches, which continue to the base of the sheath, where they are attached. The sheath extends to the third or fourth row of ventral spines.

An oblong granular mass was noted about the middle of the proboscis, seen in a thin section, and on its inner wall. A round granular mass about 0.07^{mm} in diameter was seen near the base of the neck in one section. I could find no indication of a ganglion in the base of the proboscis sheath.

Measurements of mounted specimens.

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of specimen	6.40	7.80	9.20	8.20
Length of proboscis	1.20	0.90	.....	1.20
Breadth of proboscis near apex	0.44	0.48	0.52	0.46
Breadth of proboscis at base	0.26	0.32	0.46	0.36
Breadth of body at anterior	.....	0.50	.....	.....
Breadth of body at median	0.54	0.92	0.74	0.80
Breadth of body at posterior	0.30	0.46	0.40	0.40
Length of proboscis sheath	.....	1.80	.....	.....
Length of neck	.....	.....	.....	0.36
Number of rows of spines on body	21	.....	.....	18

Nos. 1 and 2 were from *Cynoscion regale*, No. 3 from *Pomatomus saltatrix*, and No. 4 from *Paralichthys dentatus*.

The length of the larger hooks on the proboscis is about 0.08mm; of the spines on the collar from 0.05mm to 0.06mm; of the spines in the ventral rows from 0.06mm to 0.07mm.

In specimen No. 1, of which measurements are given above, the number of spines visible on side in the first ventral row was 24; the number visible on one side in the second to the twenty-first rows, respectively: 16, 13, 13, 16, 17, 13, 13, 12, 12, 10, 11, 12, 11, 9, 9, 9, 8, 7, 10, 6.

Habitat.—Common Flounder (*Paralichthys dentatus*), Squeteague (*Cynoscion regale*), Bluefish (*Pomatomus saltatrix*). In peritoneum and mesentery. Wood's Holl, Mass., July and August, 1884–'85.

Echinorhynchus proteus Westrumb.

[Plate VI, Figs. 3–5.]

Dujardin, Hist. Nat. des Helminth.,p. 529. Molin, in Sitzungsb. d. Kais. Akad. d. Wissensch., xxx, 143, and xxxiii, 295. Leidy, Proceed. Acad. Phila., v, 208, and viii, 48. Greef, Wiegmann's Archiv, i, 361–375, tab. vi. Pagenstecher, Z. f. w. Z., xiii, 413, tab. xxiii–xxiv. Leuckart, Mensch. Paras., ii, 785–817. Molin, Denksch. d. K. Akad., xix, 272–3, tab. ix, fig. 2–3.

For detailed synonymy and habitats see Diesing, Systema Helminth., ii, 51–53, and Revis. der Rhyngo., 754.

Proboscis cylindrical or often subclavate, with about 6 to 8 longitudinal series of recurved hooks visible on one side, 12 to 20 in each series. Median and anterior hooks flat and thin, postero median and posterior, slender. A thin-walled, spherical bulla immediately back of the proboscis, followed by a long, slender, cylindrical neck. Body fusiform, slightly swollen and rounded anteriorly, obtusely rounded posteriorly; color varying from light lemon-yellow to orange. Length, 15mm to 23mm.

Measurements of a living specimen.

	Millimeters.
Length of specimen	23.00
Length of proboscis	0.75
Diameter of bulla	1.75
Length of neck	4.50
Length of body	16.00
Diameter of body, anterior	2.00
Diameter of body, posterior end	0.77
Diameter of neck, median	0.25
Diameter of proboscis, anterior	0.17
Diameter of proboscis, median	0.31

These parasites were found in great numbers attached to the inner wall of the large intestine of the Striped Bass (*Roccus lineatus*). They differ from most intestinal parasites in being highly colored. While the prevailing color is orange of different shades, many were observed which were a light lemon-yellow, and others intermediate between these colors.

The presence of these parasites in considerable numbers must be injurious to the host, since they are always firmly attached and usually cause much local inflammation. In many cases the proboscis was found to have penetrated the walls of the intestine and to be protruding into the body cavity. In most instances of this kind it was surrounded by an abnormal secretion from the tissues of its host. This secretion is of a dark-brown, cinnamon-brown, or amber color. In many cases the proboscides were found to have become nuclei, around which were formed, in concentric layers, calculi of this abnormal deposition. The whole is further inclosed in a thickened cyst composed of two or three layers of connective tissue over which is thrown a thin outer covering of peritoneum. A cluster of these encysted calculi, lying in the peritoneum of the large intestine of a specimen of Striped Bass (*Roccus lineatus*), is shown in Fig. 5; one of the cysts opened, in Fig. 5*a*; and a cross-section of a calculus removed from its cyst in Fig. 5*b*. The diameter of one of the largest cysts was 18^{mm}. In the calculus figured the diameter is 15^{mm}. The color on the surface is, when the calculus is placed in alcohol, a beautiful rich golden-brown with a silky luster. The surface is uneven, with little irregular rounded or mammillary eminences. The nucleus is irregularly linear, 1½ to 2^{mm} in length. The inner layers are thin, irregularly concentric and darker in color than the outer layers. Outside of this central, dark portion is a lighter ring about 2½^{mm} thick and made up of a great many thin, concentric layers. This lighter portion is sharply marked off from the remaining outer part of the calculus, separates from it easily, and can be removed from the half-calculus, as one cupel can be taken out of a nest made up of graded sizes. The outer ring is about 3^{mm} thick, is a little darker than the middle ring, but, like it, is made up of a number of thin, concentric layers. The layers of the two outer rings are more regularly concentric than those of the inner portion. The color of the cut part of the calculus is a little darker than that of the surface, and the luster is waxy. A piece of one of these secretions burned readily and left a small quantity of ash which was composed largely of calcium carbonate. In one, from which the alcohol had evaporated, crystals were noticed which had the general habit and appearance of those of oxalate of urea.

Alcoholic specimens are uniformly white in color.

Habitat.—Striped Bass (*Roccus lineatus*); large intestine; Wood's Holl, Mass., August and September, 1884–'85.

List of Entozoa described in this paper, with their hosts.

Entozoa.	Host.	Page.	Plate.	Figures.
1. *Dibothrium manubriforme* sp. nov	Spear Fish (*Tetrapturus albidus*).	4	I	1–4
2. *Dibothrium aluteræ* sp. nov	File Fish (*Alutera Schœpfii*)	6	I	5–8
3. *Echeneibothrium variabile* Van Beneden	Common Skate (*Raia erinacea*)	8	I	9–13
4. *Spongiobothrium variabile* gen. et sp. nov	Sting Ray (*Trygon centrura*)	10	II	13–19
5. *Phyllobothrium thysanocephalum* sp. nov	Tiger Shark (*Galeocerdo tigrinus*).	12	II	1–12
6. *Orygmatobothrium angustum* sp. nov	Dusky Shark (*Carcharias obscurus*).	16	III	1–3
7. *Crossobothrium laciniatum* gen. et sp. nov	Sand Shark (*Odontaspis littoralis*).	18	III	4–18
8. *Phoreiobothrium lasium* gen. et sp. nov	Dusky Shark (*Carcharias obscurus.*)	22	IV	24–29
9. *Calliobothrium verticillatum* Rudolphi	Smooth Dogfish (*Mustelus canis*)	24	IV	1–8
10. *Rhynchobothrium bisulcatum* sp. nov	Dusky Shark (*Carcharias obscurus.*)	27	IV	9–23
11. *Rhynchobothrium tenuicolle* Rudolphi	Smooth Dogfish (*Mustelus canis*).	34	V	17–18
12. *Tænia dilatata* sp. nov	Common Eel (*Anguilla vulgaris*)	36	V	14–16
13. *Echinorhynchus agilis* Rudolphi	*Anguilla vulgaris* and *Carcharias obscurus.*	38	V	1–6
14. *Echinorhynchus acus* Rudolphi	Flat Fish (*Pseudopleuronectes americanus*).	40	V	7–13
15. *Echinorhynchus sagittifer* sp. nov	Common Flounder (*Paralichthys dentatus*), Squeteague (*Cynoscion regale*), and Bluefish (*Pomatomus saltatrix*).	41	VI	1–2
16. *Echinorhynchus protcus* Westrumb	Striped Bass (*Roccus lineatus*)	44	VI	3–5
17. Embryo *Tetrabothria*	Squeteague (*Cynoscion regale*)	1	VI	6–9

WASHINGTON AND JEFFERSON COLLEGE,
Washington, Pa., June 1, 1886.

EXPLANATION OF PLATE I.

FIG. 1. *Dibothrium manubriforme* sp. nov. Adult strobile, natural size.

FIG. 1*a*. Median segments of same, enlarged 3 diameters.

FIG. 1*b*. The same, opposite side, showing genital openings, enlarged 3 diameters.

FIG. 2. Head and anterior segments of young specimen, enlarged 12 diameters.

FIG. 3. Posterior segments of adult, enlarged 10 diameters.

FIG. 4. Ova. *a*, ova with white opaque shell; *b*, ova with thin transparent shell, enlarged 150 diameters.

FIG. 5. *Dibothrium alutacæ* sp. nov. Head and anterior segments, marginal view, enlarged 4 diameters.

FIG. 6. Lateral view of same specimen, enlarged 4 diameters: length of specimen 27^{mm}.

FIG. 7. Lateral view of head of another specimen, enlarged 4 diameters; bothria contracted and concave.

FIG. 8. Posterior end of same specimen, enlarged 4 diameters; length of specimen 76^{mm}.

FIG. 9. *Echeneibothrium variabile* Van Beneden. Front view of head as seen in living specimens, when the sucking disks are applied to the under surface of the cover-glass, enlarged 36 diameters.

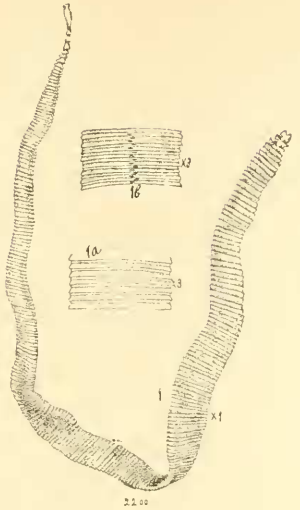
FIG. 10. Outline of median, irregular segments, enlarged 10 diameters.

FIG. 11. Outline of other segments farther back, showing position of genital aperture, enlarged 10 diameters.

FIG. 12. One of the same, compressed, showing the genitalia, enlarged 20 diameters.

FIG. 13. Lateral view of head, alcoholic specimen, enlarged 20 diameters.

Figures 1, 2, and 9 from life; others from alcoholic and mounted specimens.
All figures made by Mrs. Edwin Linton.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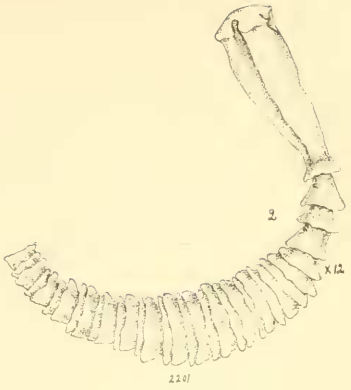
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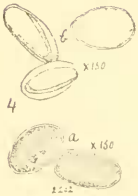
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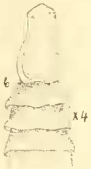
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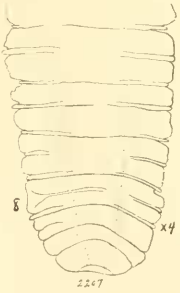
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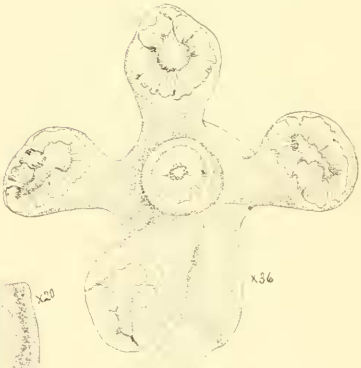
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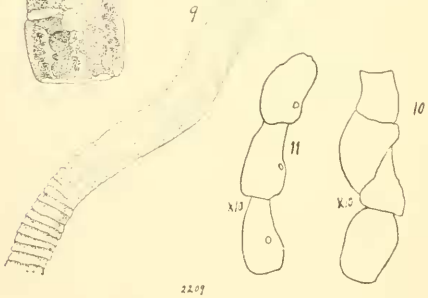
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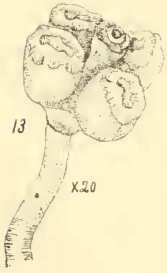
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EXPLANATION OF PLATE II.

FIG. 1. *Phyllobothrium thysanocephalum* sp. nov. Head and part of neck of adult, natural size, length of specimen 1 meter.

FIG. 2. Part of body of same, showing the beginning segments, enlarged 2 diameters.

FIG. 3. Segments near posterior end of adult, enlarged 2 diameters.

FIG. 4. Mature free proglottis, enlarged 2 diameters.

FIG. 5. Mature free proglottis, flattened under compressor, enlarged 4 diameters.

FIG. 6. Posterior segments of a specimen measuring 290^{mm} in length, enlarged 2 diameters.

FIG. 7. Head and neck of young specimen, enlarged 12 diameters.

FIG. 7*a*. Front view of rostellum, enlarged 18 diameters.

FIG. 7*b*. Side view of same, enlarged 18 diameters.

FIG. 8. Young specimen, natural size.

FIG. 9. Transverse section through middle of head of a young specimen, length 58^{mm}, enlarged 9 diameters.

FIG. 10. Transverse section through anterior third of head of adult, enlarged 9 diameters.

FIG. 11. Transverse section through neck a short distance back of head, adult, enlarged 6 diameters.

FIG. 12. Transverse section through neck of young, near the head, enlarged 9 diameters.

FIG. 13. *Spongiobothrium variabile* gen. et sp. nov., outline of strobile with regular slender segments, enlarged 5 diameters.

FIG. 14. Outline of another specimen with shorter and more irregular segments, enlarged 6 diameters.

FIG. 15. Side view of head, neck, and anterior segments, edges of bothria contracted, enlarged 10 diameters.

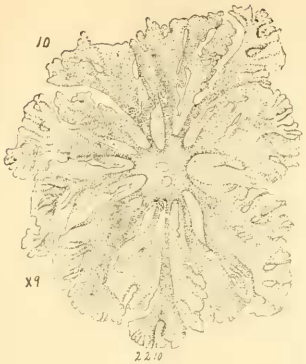
FIG. 16. Front view of head of another specimen, with two bothria expanded, enlarged 10 diameters.

FIG. 17. Three mature segments, enlarged 5 diameters.

FIG. 18. Median segment, enlarged 20 diameters.

FIG. 19. Mature segment, enlarged 20 diameters.

Figures 3, 4, 6, 7, 8, and 15 from life; others from alcoholic and mounted specimens. All figures made by Mrs. Edwin Linton.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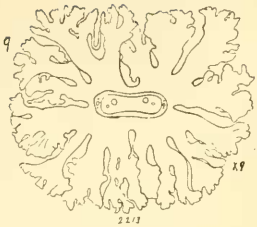
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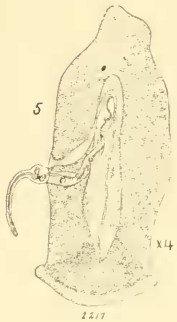
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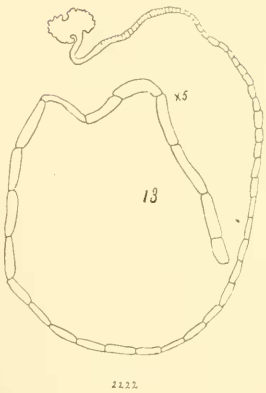
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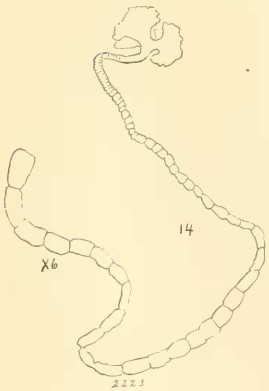
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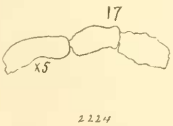
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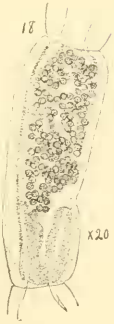
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15
x10
2225


x10
16
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EXPLANATION OF PLATE III.

FIG. 1. *Orygmatobothrium angustum* sp. nov., outline of strobile, enlarged 8 diameters.

FIG. 2. Head and part of neck of same, enlarged 20 diameters.

FIG. 3. Posterior segment of same, enlarged 20 diameters.

FIG. 4. *Crossobothrium laciniatum* gen. et sp. nov., adult strobile, in fresh water, natural size.

FIG. 5. Head and first segments of same specimen, enlarged 12 diameters.

FIG. 6. Head and first segments of a specimen after lying for a few minutes in fresh water, enlarged 8 diameters.

FIG. 7. Posterior segments of same, enlarged 6 diameters.

FIG. 8. Posterior segments of another specimen, showing lateral openings for the discharge of ova, enlarged 6 diameters.

FIG. 9. Head and first segments of adult, showing one position of bothria while in motion. The bothrium in front view and the one opposite (not shown in sketch) are thrust forward, enlarged 10 diameters.

FIG. 10. The same, with one bothrium flattened out and applied to the bottom of the watch-glass, enlarged 10 diameters.

FIG. 11. The same with two bothria pushed forward, the ends extended and curled outward, enlarged 10 diameters.

FIG. 12. Free proglottis showing lateral opening for discharge of ova, enlarged 6 diameters.

FIG. 13. Free proglottis before the ova are discharged, flattened under the compressor, enlarged 10 diameters.

FIG. 14. Another after most of the ova have been discharged from the lateral opening, also flattened under compressor, enlarged 10 diameters.

FIG. 15. Front view of head of specimen transferred from fresh water to alcohol, enlarged 10 diameters.

FIG. 16. Transverse section through another specimen, enlarged 10 diameters.

FIG. 17. Young strobile before segments have made their appearance near the head. The joints at the posterior end are pseudosegments; flattened under compressor, enlarged 12 diameters.

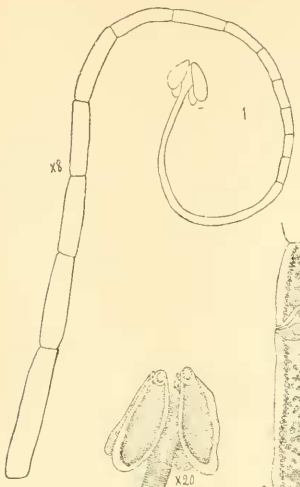
FIG. 18. Head and anterior part of a young specimen in fresh water, enlarged 12 diameters.

FIG. 18*a*. Anterior segments of same, enlarged 12 diameters.

FIG. 18*b*. Posterior segments of same, enlarged 12 diameters.

Figures 9, 10, 11, 13, 14, and 17, from living specimens in sea-water; figures 4, 5, 6, 7, 8, 18, 18*a*, and 18*b*, from living specimens in fresh water; others from alcoholic and mounted specimens.

All figures made by Mrs. Edwin Linton.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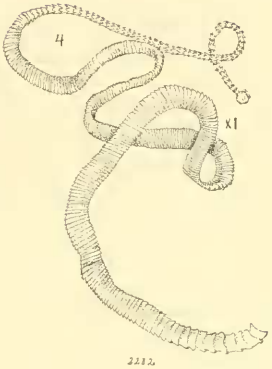
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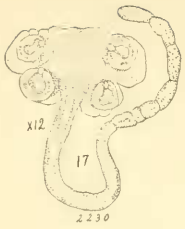
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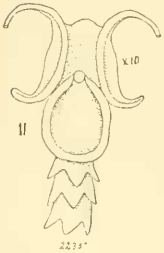
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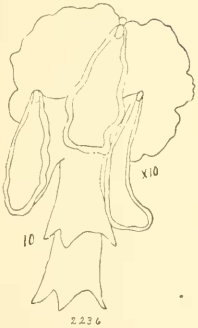
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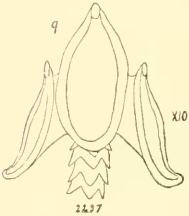
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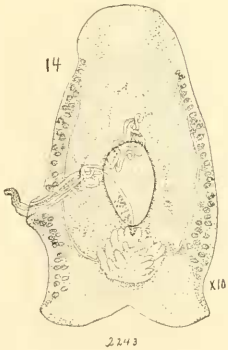
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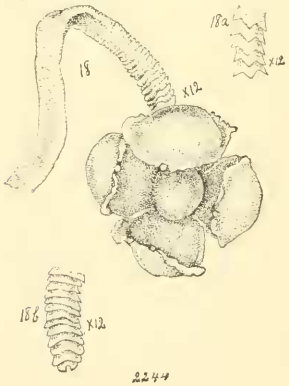
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